2002

Report of the Fraser River Panel to the Pacific Salmon Commission on the 2002 Fraser River Sockeye Salmon Fishing Season

Prepared by the

Pacific Salmon Commission

June, 2005

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REPORT OF THE

FRASER RIVER PANEL

TO THE PACIFIC SALMON COMMISSION

ON THE 2002 FRASER RIVER

SOCKEYE SALMON FISHING SEASON

2002 PANEL MEMBERS AND ALTERNATES

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June, 2005

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I. EXECUTIVE SUMMARY

1. In 2002, the Fraser River Panel managed fisheries that targeted Fraser River sockeye salmon in the Panel Area, under the terms of Annex IV of the Pacific Salmon Treaty that was revised on June 30, 1999. Chapter 4 of the Agreement provided catch sharing arrangements for Fraser River sockeye and pink salmon for the years 1999-2010. Under the terms of the Agreement, the 2003 United States sockeye catch in Panel Areas (Washington) was not to exceed 16.5% of the Total Allowable Catch (TAC) of Fraser River sockeye salmon minus a payback of up to 56,000 fish due to a catch overage carried forward from 2001. Panel Area fisheries in Canada were to be managed by the Fraser River Panel, while Canadian fisheries outside the Panel Area were to be managed by Canada in a manner that considered catches in United States fisheries.

2. An agreement on June 12, 2002 established a new process for making Panel decisions and calculating the TAC during the 2002 management season, and for calculating overages and underages to be paid back in future years. A subsequent agreement on February 17, 2005 (including a revised Chapter 4, Annex IV of the Pacific Salmon Treaty) retroactively modified the TAC and payback provisions for 2002.

3. Prior to the fishing season, the Panel recommended a fishery regime and management plan for Panel Area fisheries to the Pacific Salmon Commission. The plan was based on abundance, timing forecasts, and escapement targets for Fraser River sockeye salmon provided by Fisheries and Oceans Canada. The plan was also based on international allocation goals set in the Agreement, domestic allocation goals set by each country, management concerns for other stocks and species identified by each country, historic migration patterns, and fisheries dynamics.

4. The Fraser River Panel managed commercial net fisheries and the Canadian "inside" troll fishery in the Panel Area under the terms of the Agreement. The United States catch in Panel Areas (Washington) was not to exceed 16.5% of the Total Allowable Catch (TAC) of Fraser River sockeye salmon, minus a payback to Canada of 56,000 fish from past years. Panel Area fisheries in Canada were managed by the Fraser River Panel and Canadian fisheries outside the Panel Area were to be managed by Canada in a manner that anticipated and accommodated catches in United States fisheries.

5. Canada provided the Panel with run-size forecasts on February 13 and 14, 2002 and rules for calculating spawning escapement targets for Fraser River sockeye salmon on April 16 and 17, 2002. Canada provided run-size forecasts at the following probability levels: 25%, 50%, 75%, 80% and 90%.

6. On June 19 and 20, 2002, the Panel developed fishery plans for forecast run sizes at the 50%, and 75% probability levels, which were 13,366,000 and 7,911,000 sockeye, respectively (Note: these forecasts included previously unforecasted stocks that were not included in the run-size forecasts provided on February 13 and 14, 2002). The corresponding spawning escapement targets were 5,325,000 and 3,967,000 fish, respectively. The projected Total Allowable Catches (TAC) at these run sizes were 6,315,000 and 3,255,000 fish, respectively.

7. Domestic allocation goals in Washington were as follows: Treaty Indian fishers were allocated 67.7% of the United States TAC minus 23,000 fish of the 56,000 fish payback, while Non-Indian fishers were allocated the remaining 32.3% of the United States TAC minus 33,000 fish of the 56,000 fish payback. Among Treaty Indians, fishers in Areas 4B, 5 and 6C were allocated a minimum of 12.5% of the Treaty Indian share. The allocation targets among Non-Indian fishers were 54% for purse seines, 41% for gillnets and 5% for reefnets, as in recent years.

8. The commercial share of the Canadian TAC was 4,728,000 fish. The sharing arrangements among commercial fishers were as follows: 37% for Area B purse seines; 14.5% for Area D gillnets; 28.5% for Area E gillnets; 8% for Area G trollers; and 12% for Area H trollers.

9. The Management Plan focussed on the harvest of Early Summer-run and Summer-run sockeye (mainly Quesnel), which were forecast to be the predominant run timing-group in 2002. Fishery restrictions were anticipated during the early season to minimize harvest impacts on Early Stuart and Early Summer-run sockeye and in the late season to protect "true" Late-run (Adams, Lower Shuswap, Portage, Weaver, Harrison, Cultus, but not Birkenhead sockeye). A 15% exploitation rate limit for true Late-run sockeye was imposed due to probable early river entry and associated high mortality rate of true Late-run sockeye. Several Fraser River and non-Fraser River chinook, chum, coho, and steelhead stocks were identified by each country as warranting conservation concerns.

10. Research studies were conducted to help determine the cause(s) of early river-entry behaviour of Late-run sockeye. This research included tagging, physiology, parasitology, oceanography and other studies.

11. The forecast of the diversion rate of Fraser River sockeye through Johnstone Strait was 27%. The run-timing forecasts (50% cumulative migration date through Canadian Area 20 - Juan de Fuca Strait) were June 30 for Early Stuart sockeye and August 8 for Chilko sockeye.

12. Catches of Fraser River sockeye salmon in all fisheries totalled 4,223,000 fish. Canadian catches totalled 3,617,000 sockeye, United States catches totalled 450,000 fish, and test fishery catches totalled 156,000 sockeye. Canadian sockeye catches were comprised of commercial catches of 2,218,000 fish; First Nations' catches of 1,155,000 fish; recreational catches of 128,000 fish; charter catches of 7,000 fish; and 109,000 Weaver Creek sockeye were caught in an ESSR (excess salmon to spawning requirements) fishery and spawning channel surplus removals. Within the United States catch, commercial fishers harvested 435,000 fish and 15,000 fish were taken in Treaty Indian ceremonial and subsistence fisheries. The sum of commercial fishery catches in both countries was 2,653,000 fish.

13. The Stock Monitoring Program provided in-season estimates of abundance, migration timing and diversion rate of Fraser River sockeye salmon throughout the fishing season. Peak migration timing referenced to Area 20 was July 4 for Early Stuart sockeye (one day later than normal for the cycle line), July 30 for Early Summer-run sockeye (two days later than expected) August 8 for Summer-run sockeye (four days later than normal) and August 13 for Late-run sockeye (approximately seven days earlier than normal). The overall diversion rate of Fraser sockeye through Johnstone Strait in 2002 was estimated at 51%.

14. The Racial Identification Program provided estimates of stock composition for commercial, First Nations and test fishery catches. DNA data, scale characteristics, parasite data and length data were employed to estimate stock proportions. These stock proportion estimates were then used to estimate the run size and gross escapement of individual stock groups. Results of DNA analyses were primarily used in 2002 due to the high accuracy of this stock identification methodology.

15. Post-season estimates of the total adult abundance of the Summer-run and Late-run run timing-groups have higher than normal uncertainty due to a lack of spawning ground assessments on some systems. Post-season estimates of total adult abundance by run-timing group were 62,000 Early Stuart, 801,000 Early Summer-run, 6,352,000 Summer-run and 7,917,000 Late-run adults, for a total of 15,132,000 adult Fraser sockeye. The abundance of Early Stuart and Summer-run sockeye was 41% and 29% lower, respectively, than the 50% probability level forecasts, while the abundance of Early Summer-run and Late-run sockeye was 18% and 121% higher, respectively than the forecast. Overall, the actual return was 13% higher than the forecast of 13,366,000 adults at the 50% probability level. Among Early Summer-run stocks, the Scotch/Seymour stock-group dominated the run. Among the Summer-run stocks, Quesnel sockeye comprised the largest portion of the production. The largest Late-run return was to Adams/Lower Shuswap stocks.

16. The pre-season exploitation rate limit on Late-run sockeye (excluding Birkenhead) of 15% was achieved. The post-season estimate of the Late-run exploitation rate was 13% with Weaver Creek ESSR catches and spawning channel surplus removals excluded from this estimate and 15% with these catches included in the estimate.

17. Estimates of spawning escapements to enumerated streams in the Fraser River watershed totalled 7,973,000 adult sockeye. Spawning ground assessments of Quesnel sockeye (with the exception of the Mitchell stock) and Birkenhead sockeye were not conducted in 2002, therefore this estimate of the total Fraser sockeye escapement in 2002 is incomplete. Spawning escapement estimates were lower than the brood year for Early Stuart (-19%) and 102% higher than the brood year for Early Summer-run sockeye. Upstream spawning ground enumeration for Summer-run and Late-run sockeye was incomplete in 2002; therefore, a direct comparison with brood-year escapement levels for these run-timing groups cannot be made. The success of spawning by female sockeye in the entire watershed in 2002 averaged 96%.

18. Adjusted gross escapement targets (target + management adjustment) for sockeye salmon were achieved or substantially exceeded for each run-timing group based on lower river estimates (in-season Mission escapement plus First Nations' catch below Mission). By this measure, gross escapements were achieved for Early Stuart sockeye and exceeded by 252,000, 1,987,000 and 224,000 fish, respectively, for Early Summer-run, Summer-run and Late-run sockeye, for a total of 2,463,000 sockeye over the adjusted gross escapement target. Gross escapement overages for these runs were largely due to Panel action designed to maximize the escapement of Early Stuart, Early Summer-run and Late-run sockeye.

19. Upriver estimates of gross escapement (catch plus spawning escapement) totalled 1,576,000 sockeye more than the unadjusted target. Gross escapements were 32,000 fish under for Early Stuart, 201,000 fish over for Early Summer-run, 1,554,000 fish over for Summer-run and 147,000 fish under for Late-run sockeye. However, because spawning ground assessments were not conducted for most Summer-run sockeye (i.e., Quesnel) and the Birkenhead stock, upriver estimates of gross escapement are more uncertain than usual. The shortfall in Early Stuart escapement was likely due to en route mortalities caused by high river flows during their upstream migration.

20. Chapter 4, Annex IV, of the Pacific Salmon Treaty was revised on February 17, 2005, and on February 18, 2005 the Commission provided the Panel with guidance based on this revised agreement. The Panel also agreed that for 2002, 2003 and 2004 a method for calculating the TAC and assessing the achievement of international allocations based on in-season estimates of run size, spawning escapement targets and management adjustments would be shown in the Fraser River Panel annual report for each year. The new calculation method resulted in a TAC of 5,744,000 Fraser sockeye. Washington fishers caught 449,000 fish, which was 452,000 fewer fish than their share of the TAC. The catch by Canadian fishers was 1,734,000 fish less than their share.

21. Domestic allocation goals in the United States were achieved with relatively good accuracy. Treaty Indian fishers caught 3,000 fish less than their allocation and Non-Indian fishers caught 3,000 fish more than their allocation. Among Treaty Indians, the minimum catch in Areas 4B, 5 and 6C of 12.5% of the Treaty Indian share was achieved. Among Non-Indian fishers, purse seines and reefnets each exceeded their allocation targets by 2,000 and 11,000 fish, respectively, while gillnets were 13,000 fish below their target allocation.

22. Domestic allocation goals in Canada were not achieved, largely because of the substantial fisheries restrictions to conserve Late-run sockeye. Within the Canadian commercial catch of 2,218,000 Fraser sockeye, Area B purse seines were 83,000 fish under, Area D gillnets were 79,000 fish under, Area E gillnets were 318,000 fish over, Area G trollers were 22,000 fish under and Area H trollers were 134,000 fish under their allocations.

23. The restrained fisheries in 2002 resulted in low by-catches of other species and stocks that were identified as conservation concerns by the Parties.

24. Based on the catch sharing agreements in place during the 2002 season, the United States had an overage of 9,000 sockeye and an underage of 21,000 pink salmon, to be carried forward as catch paybacks and used in TAC calculations in 2003.

II. FRASER RIVER PANEL

Under the Pacific Salmon Treaty, the Fraser River Panel is responsible for in-season management of fisheries that target Fraser River sockeye and pink salmon within the Panel Area (Figure 1). Prior to the fishing season, the Panel recommends a fishery regime and a management plan for Panel Area fisheries to the Pacific Salmon Commission (PSC). The plan is based on: (1) abundance and timing forecasts and escapement targets for Fraser River sockeye and pink salmon stocks provided by Fisheries and Oceans Canada (DFO); (2) international catch allocation goals set by the agreements between the Parties; (3) domestic catch allocation goals of each country; (4) management concerns for other stocks and species also identified by each country; and (5) historic patterns in migration and fisheries dynamics. The objectives that guide the Panel's decision-making listed in descending priority are: to achieve the spawning escapement targets, meet international catch allocation goals, and meet domestic catch allocation objectives. Conservation concerns of the Parties for other species and stocks are addressed throughout the process.

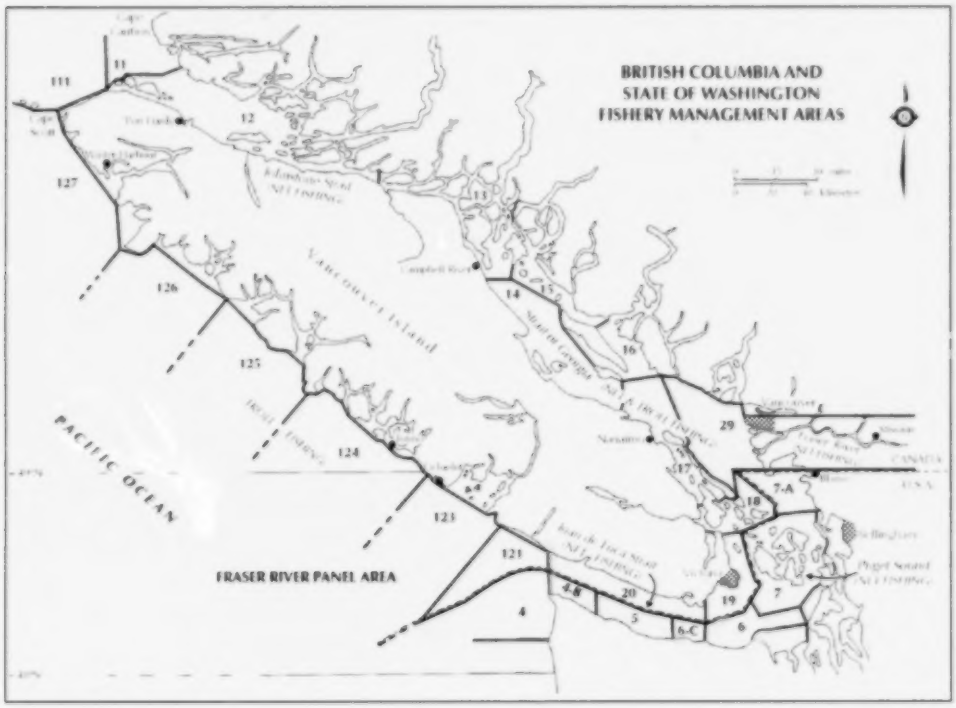

Figure 1. Fishery management areas and commercial gear used in the Fraser River Panel Area and Canadian south coast waters.

In 2002, the pre-season management plan adopted by the Panel was based on fishery scenarios that were designed to achieve the escapement targets and catch goals, given two levels of pre-season expectations. These were the 50% and 75% probability level forecasts of abundance. The two scenarios provided the Panel with approximate dates of first openings in each Panel Area fishery. Using in-season commercial and test fishing data and analyses from PSC staff, the Panel developed a weekly fishing pattern in response to in-season deviations from expectations. The Fraser River Panel Technical Committee, who worked in conjunction with the PSC staff, provided their respective National sections of the Panel with technical advice, which in turn facilitated the activities of the Panel.

Under the terms of the revised Chapter 4 of Annex IV of the Pacific Salmon Treaty (1999) between Canada and the United States, the Panel exercised its regulatory mandate in Panel Areas only for commercial net fisheries and the Canadian inside (Strait of Georgia) troll fishery directed at Fraser River sockeye salmon. The development of management approaches for other species and stocks intercepted in south coast areas are the responsibility of the Southern Panel and the Commission. The actual management in specific areas is the responsibility of the appropriate country.

The Panel membership and their affiliations during the 2002 season were:

UNITED STATES	CANADA
Members	
Mr. R. Lincoln, Chair Washington Department of Fish and Wildlife	Mr. W. Saito, Vice-Chair Fisheries and Oceans Canada
Mr. D. Cantillon National Marine Fisheries Service	Mr. M. Chatwin Salmon processing industry
Mr. R. Kehoe Commercial salmon fishing industry	Mr. M. Griswold Troll fisher
Ms. L. Loomis Treaty Indian tribes	Mr. T. Lubzinski Gillnet fisher
	Chief S. McKamey Canadian First Nations
	Mr. L. Wick Purse seine fisher
Alternates	
Mr. R. Charles Treaty Indian tribes	Mr. B. Assu Purse seine fisher
Mr. J. Giard Commercial salmon fishing industry	Mr. W. Otway Sport fisher
Mr. P. Patillo Washington Department of Fish and Wildlife	Mr. L. Rombough Gillnet fisher
Mr. W. Robinson National Marine Fisheries Service	Mr. P. Ryall Fisheries and Oceans Canada
	Mr. P. Sakich Troll fisher

III. INTRODUCTION

The continuing early upstream migration of "true" Late-run sockeye (Adams, Lower Shuswap, Portage, Weaver, Harrison, Cultus, but not Birkenhead sockeye) was the most serious issue facing the Fraser Panel in 2002. In 2000 and 2001, the en route mortality rate of true Late-run sockeye was estimated at approximately 90%. In addition to providing an update on the Late-run sockeye conservation problem and the status of environmental management adjustments, the summary below highlights issues encountered during the 2002 season including: the pre-season planning process, in-season management, a comparison of forecast to actual returns of Fraser sockeye, and a comparison of the Mission-based and spawning ground estimates of gross escapement.

Review of the 2002 Season

Prior to the 2002 season, the Commission provided the Panel with guidance on two issues (Appendix B). First, the Commission instructed the Panel to determine TAC in post-season calculations based on the final in-season spawning escapement targets, rather than the actual spawning escapement obtained as specified in Annex IV, Chapter 4 of the Pacific Salmon Treaty. Second, the Commission provided instructions to the Panel and the PSC staff on a new in-season decision process. Prior to 2002, the PSC staff made recommendations to the Panel for fisheries in Panel waters. These recommendations were then subject to modification by the Panel and approval required bilateral agreement by the Parties. Under the new decision process, the Parties made fisheries recommendations, and staff evaluated these proposals against criteria specified in the Treaty and the pre-season plan. If the PSC staff evaluation supported the recommendations, the Panel adopted the fisheries proposals. The Panel could also adopt fisheries proposals that were not supported by PSC staff review, through bilateral agreement.

Chapter 4, Annex IV, of the Pacific Salmon Treaty was revised on February 17, 2005 (Appendix C), and on February 18, 2005 the Commission provided the Panel with guidance (Appendix D) based on this revised agreement. The Panel also agreed that for 2002, 2003 and 2004 a method for calculating the TAC and assessing the achievement of international allocations based on in-season estimates of run size, spawning escapement targets and management adjustments would be shown in the Fraser River Panel annual report for each year.

During pre-season planning for fisheries on Fraser River sockeye in spring 2002, Fisheries and Oceans Canada identified conservation concerns for Early Stuart and Late-run sockeye run-timing groups, which were forecast to be weak (Early Stuart) or in need of special protection (Late-run stocks) (Appendix A, Table 1). The Panel was faced with the challenge of determining how to harvest Early Summer-run and Summer-run stocks without adversely impacting co-migrating sockeye from the other run-timing groups. A short "window of opportunity" was identified by the Fraser River Panel Technical Committee and PSC staff. The Panel considered many fishery options and adopted a pre-season fishing plan on June 20. The main intent of the fishing plan was to focus harvest on anticipated sockeye surpluses for Early Summer-run and Summer-run stocks while minimizing the harvest impacts on Early Stuart and Late-run sockeye.

Conservation concerns for Early Stuart sockeye arose from a combination of en route and pre-spawning mortality of adult sockeye and low egg-to-fry survival from the 1998 brood year. Early Stuart sockeye encountered high Fraser River water temperatures during their upstream migration in 1998, resulting in high en route mortality (75%) and pre-spawning mortality rates (44%) (FRP report 1998). Adult fish that survived to spawn were stressed and egg-to-fry survival rates were below average in two of the three Early Stuart index streams. The Panel implemented a closure of commercial fishing in Panel Area waters during the migration of Early Stuart sockeye to mitigate the adverse production impacts that occurred in 1998. In addition, test fisheries for Early Stuart sockeye were restricted.

Conservation requirements for true Late-run sockeye resulted from recent observations of very high en route and pre-spawning mortality associated with their extremely early migration into

the Fraser River. Furthermore, the dominant cycle-line return for the Late Shuswap stocks was 2002 and the 2002 forecast of returns for these stocks was only about half the average of past years. The low forecast for this cycle was due in part to probable high en route losses sustained in the brood year. The Panel was concerned that this pattern of early in-river migration and high mortality would occur again in 2002. The Panel agreed that fisheries in Panel Area waters would be limited to ensure that the exploitation rate on true Late-run sockeye salmon (excluding Birkenhead sockeye) in all fisheries would not exceed 15%. United States fishers would be limited to their share of the proportion of the TAC (16.5%) based on the 15% total harvest rate limit on Late-run sockeye. To achieve this low exploitation rate on Late-run sockeye, the harvest of Early Summer-run and Summer-run stocks was expected to be limited to a three-week period beginning in late July and ending in mid August.

In-season estimates of sockeye returns varied substantially from the pre-season forecasts of abundance. Early Stuart and Summer-run returns were low and near the 75% probability level forecasts while Early Summer-run sockeye abundance was near the 25% probability level. Late-run sockeye returns exceeded pre-season expectations and returned at a level of less than 5% probability that the run would have reached the estimated abundance.

The pre-season fishing plan assumed that the migration peaks of Summer-run and Late-run sockeye in marine areas would be separated by about 16 days (based on historical average timing). However, Late-run sockeye were identified in marine area test-fisheries in late July and by the first week of August catches of Late-run sockeye were approaching the 15% exploitation rate limit in fisheries (based on their 50% probability level forecast of abundance). Due to the earlier than expected arrival of Late-run stocks and uncertainty in the estimate of Late-run abundance (it was unknown whether Late-run sockeye were earlier and/or larger than forecast), the Panel revised the 15% exploitation rate limit on Late-run stocks on August 9 to exclude catches that occurred in the lower Fraser River prior to August 17. This was due to an assumed very high mortality on these early-migrating Late-run sockeye, which was based on tagging studies conducted in the Harrison River in 2001. The modification of the fishing plan permitted fisheries during the subsequent week. In-season estimates of Late-run abundance continued to increase gradually following the arrival of a second peak of sockeye abundance during the week of August 12. A smaller, third peak of Late-run sockeye migrated through the marine approach areas the following week. Furthermore, while the initial indications suggested very early upstream migration in 2002 (e.g. earliest arrival at Sweltzer Creek Fence (Cultus) on record, August 3, 2002), most Late-run sockeye held in the Strait of Georgia prior to migrating upstream in mid September.

The in-season projections of upstream escapements (based on Mission hydroacoustic estimates) for all four run-timing groups were higher than the upstream spawning ground estimates (Early Stuart: 61,000 vs. 25,000 fish; Early Summer-run: 647,000 vs. 457,000 fish; Summer-run: 4,917,000 vs. 3,804,000 fish; and Late-run: 6,627,000 vs. 5,915,000 fish). This was because only a partial spawning ground enumeration program was conducted on Quesnel sockeye in 2002 and there was no spawning ground enumeration program conducted on Birkenhead sockeye. Consequently, estimates of upstream escapement of Summer-run and Late-run sockeye may have a higher degree of uncertainty associated with them than normal.

Early Stuart sockeye encountered high Fraser River discharge conditions, which may have resulted in large en route losses. The differences between in-season projections and upstream estimates were very similar to a projection from the Environmental Management Adjustment (EMA) model, which incorporates the effects of discharge on survival to their spawning grounds. Differences between estimates for this run-timing group were attributable to a combination of en route losses and errors in the estimation methods (either at Mission and/or upstream). A primary source of the difference between estimates for Summer-run sockeye was likely an incomplete escapement enumeration program for Quesnel sockeye. Estimates were not obtained for Horsefly River populations or any Quesnel lake tributaries with the exception of the Mitchell River and Cameron and Penfold Creeks.

Late-run sockeye suffered en route and pre-spawning losses again in 2002, but the mortality rate was much lower than observed in recent years. The lower rate was likely due to the later river-entry timing of Late-run sockeye in 2002 versus 2000 and 2001. The difference between the

Mission estimates and arrivals to the spawning grounds was approximately 9%, which was consistent with the Late-run mortality rate estimate from a large-scale radio tagging program (15%). An additional factor contributing to the difference between these estimates could be the lack of an escapement enumeration program on Birkenhead sockeye in 2002. Pre-spawning mortality of Late-run females that arrived at the spawning grounds was not severe (overall <5%), however, a disk-tagging study conducted on the Late Shuswap population detected very high pre-spawning mortality rates in the earliest migrating fish (75%). Pre-spawning mortality rates declined with later arrival timing. These pre-spawning mortality rates were incremental to the en route losses and thus further reduced the number of Late-run sockeye that spawned successfully.

Environmental Management Adjustments

"Management Adjustments" are designed to increase the likelihood of successfully achieving the spawning escapement targets. These adjustments are intended to compensate for:

1. Bias in the relationships between escapement estimates in the lower river (in-season estimates from Mission hydroacoustic and test fishing programs) versus the upper river (post-season estimates from spawning ground enumerations, plus First Nations and recreational catches), probably due to various biases and errors in the catch and escapement estimates that are difficult to quantify. For Early Stuart and Early Summer-run sockeye, lower-river estimates tend to be higher than upriver estimates.
2. En route mortality due to severe conditions (high temperature or flow) in the Fraser River during migration, or early river entry of Late-run stocks (excluding Birkenhead).

The Environmental Management Adjustment (EMA) models currently used for this purpose are the result of a process that began in 1995 and 1996 when, in response to escapement shortfalls in 1992 and 1994 that were the subject of public reviews[1,2], gross escapement adjustments were implemented for Early Stuart, Early Summer-run and Summer-run sockeye. In subsequent years, models based on historic differences between lower-river and upriver gross escapement estimates (1, above) were developed and used by DFO to develop pre-season management adjustments for Early Stuart and Early Summer-run sockeye. Models were also developed for Summer-run and Late-run sockeye, but the results did not show any evidence of bias. Beginning in the late 1990s, in-season adjustments to compensate for expectations of en route mortality (2, above) were also implemented. For example, the Panel responded to high river temperatures in 1998 by implementing an in-season management adjustment of 665,000 Summer-run sockeye, and in 2000 the Panel adopted a Late-run management adjustment of 200,000 fish when in-season data indicated the run had entered the river early. The size of these management adjustments were based on professional judgment, rather than on quantitative models, because at the time, there were not enough data from years of severe mortality events to develop such models.

The next stage in the evolution of management adjustments occurred in 2001 and 2002, when the Panel provisionally adopted models for in-season use that combined the effects of the two sources. These models, developed jointly by PSC and DFO staff, predict the difference between lower-river and upriver escapement estimates based on the values of environmental or timing variables that relate to large en route losses. The predicted "difference between estimates" from the models are primarily related to en route mortality when the predictor variables are severely high (temperature and discharge) or early (Late-run timing). They are also related to trends in historical differences between lower-river and upriver estimates. For Early Stuart and Early Summer-run sockeye, which historically have sometimes been exposed to both high discharge and high temperature events that caused en route losses, the models included discharge and temperature predictor variables. The Summer-run model was based only on a temperature variable, while the model for Late-run stocks (excluding Birkenhead) was based on the date when 50% of the migration passed Mission. Estimates from these EMA models were subject to review by the Fraser River Panel Technical Committee and adoption was at the discretion of the Panel.

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[1] Pearse, P.H. 1992. Managing salmon in the Fraser River: report to the Minister of Fisheries and Oceans on the Fraser River salmon investigation with scientific and technical advice from Peter A. Larkin. Canada. Department of Fisheries and Oceans, Vancouver, BC. 36 p.

[2] Fraser River Sockeye Public Review Board (Canada). 1995. Fraser River sockeye 1994: problems and discrepancies. 131 p.

Late-run Sockeye

While there were many issues confronting the Panel in 2002, the continuing early upstream migration of Late-run sockeye was of most concern. These fish normally hold (delay) in the Strait of Georgia for three to six weeks prior to entering the Fraser River between mid-September and early October. The early upstream migration results in increased susceptibility of these fish to a myxosporean parasite, *Parvicapsula minibicornis*, that has been implicated in very high en route and pre-spawning mortality of Late-run sockeye in freshwater. While the cause of death is known, determining the cause(s) of the early upstream migration has been much more difficult. Economic support from the Pacific Salmon Commission, Canada, and the United States was used to initiate several research programs in 2002. The research areas included a large-scale radio tagging study, a smaller-scale disk tagging study, as well as studies examining physiology, parasitology, oceanography and other causal factors. A summary of the results of the 2002 studies is in Appendix E.

Early migration of Late-run sockeye into the Fraser River was observed in 2002, although the problem was much less severe than in recent years. The migration timing of these fish into the Strait of Georgia was similar to 2000 and 2001. Early in the 2002 season it was expected that the upstream migration would be similar to recent years, however, most Late-run sockeye delayed in Georgia Strait. The estimated 50% upstream migration date of Late-run sockeye in 2002 was approximately one month later than 2000 and three weeks later than 2001. The later migration of Late-run sockeye in 2002 and cooler water temperatures were likely the primary factors resulting in the much lower mortality rate in 2002 (9%).

IV. MANAGEMENT ACTIONS

A. Forecasts of Returns, Escapement Targets, and Potential TAC

Canada presented the Panel with Fraser River sockeye salmon run-size forecasts at the Fraser Panel meeting held on February 13 and 14, 2002. The data used to develop the pre-season run-size forecasts provided highly uncertain estimates of the potential return strength of sockeye stocks. This uncertainty was reflected in the range of run-sizes relating to the various probability levels of the forecast. The Panel was provided with a range of probability levels of the forecast; specifically the 25%, 50%, 75%, 80% and 90% probabilities of the Fraser sockeye run size exceeding a specified projection (Appendix A, Table 1). For planning purposes, the Panel used the 50% and 75% probability level forecasts for sockeye (12,916,000 fish and 7,694,000 fish, respectively). The 50% probability level of the forecast increased to 13,366,000 fish and the 75% probability level of the forecast increased to 7,911,000 fish, when unforecasted stocks were included in the projections.

Canada presented the Panel with the 2002 Fraser sockeye escapement goals at the Fraser Panel meeting held on April 16 and 17, 2002. They also provided a method of calculating spawning escapement targets for sockeye by stock group as a function of returning run size (Appendix A, Table 2). There were several components to the plan. The escapement targets for all run-timing groups were maintained at 50% probability forecast levels, similar to recent years. A maximum harvest rate of 64% on Summer-run sockeye was established to maintain harvest rates below 70% on Summer-run stocks. Escapement targets at the 50% probability level forecasts for the run-timing groups were proposed: Early Stuart 75,000 fish; Early Summer-run 227,000 fish; Summer-run 3,242,000 fish; and Late-run 1,781,000 fish for a total escapement goal of 5,325,000 fish. At the 75% probability level forecast the escapement goal was 3,967,000 sockeye.

Forecasts of peak arrival timing (50% run passage through Canadian Area 20) were provided for Early Stuart sockeye on July 4, and for Chilko sockeye on July 16. The 50% arrival timing forecast for Early Stuart sockeye was June 30, which was four days earlier than average. The 50% arrival timing forecast for Chilko sockeye was August 8, which was five days later than average.

On July 11, DFO also provided a forecasted sockeye salmon diversion rate through Johnstone Strait of 27%.

At a meeting on June 19 - 20, the Fraser River Panel approved the 2002 fishery management plans for Fraser River sockeye salmon in Panel Area waters. Uncertainty about the forecast abundances for sockeye stocks led the Panel to develop fishery plans at return abundances corresponding with the 50% and 75% probability level forecasts. The TACs for Fraser River sockeye were calculated using the spawning escapement targets, projected test fishery catches, proposed management adjustments, and an Aboriginal Fisheries Exemption of 400,000 Fraser sockeye as specified in Annex IV of the Pacific Salmon Treaty.

At a meeting on July 12, the Fraser River Panel endorsed the use of an EMA model for the 2002 management season. On July 19, the Panel discussed how the EMA model would be used in-season. Subsequently, at a Panel meeting on July 26, the staff recommended that the Panel adopt an Early Summer-run EMA of 43,000 fish (this assumed benign migration conditions for sockeye in the Fraser River) for use until in-season data became available to update the pre-season estimate. An EMA was not recommended for Early Stuart sockeye because the small run-size forecast did not permit directed harvest of the stock.

PSC staff provided the Panel with daily abundance curves (Figure 2) that projected the arrival of Fraser River sockeye salmon in Area 20. This figure shows the expected timing and abundance of major stocks in 2002 at the 50% probability level forecast (13,366,000 sockeye salmon).

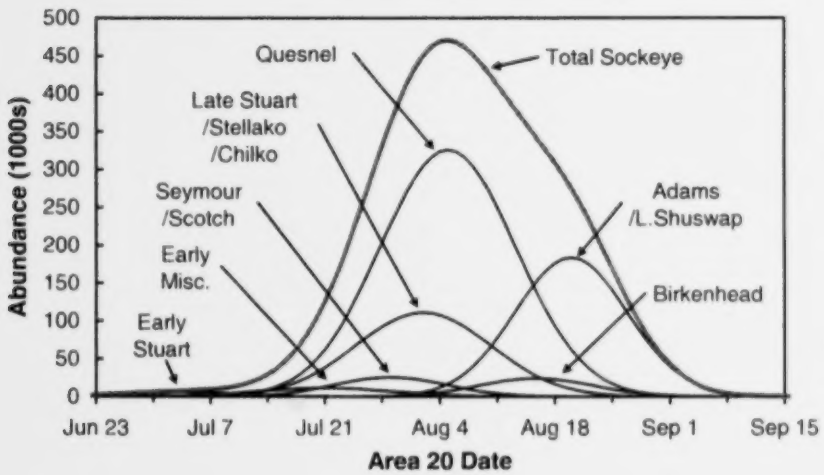

Figure 2. Expected daily abundance curves for migrating Fraser River sockeye salmon in 2002 (Area 20 date), based on forecast abundances (50% probability estimates) and timing patterns.

Based on the pre-season forecasts, escapement targets, projected test fishing catches, and Aboriginal fishery exemptions, the TACs available for international sharing were 6,315,000 sockeye (50% probability level forecast) and 3,255,000 sockeye (75% probability level forecast) (Table 1). The corresponding pre-season sockeye catch goals for Washington State fishers (16.5% of the TAC minus a 5% catch payback, up to 56,000 sockeye salmon, due to a catch overage in 2000) at the 50% and 75% probability level forecasts were 986,000 and 481,000 fish, respectively.

Table 1. Pre-season forecasts (50% probability level) of total runs, spawning escapement targets and other deductions and total allowable catches of Fraser River sockeye salmon in 2002.

		Deductions				
Run	50% Forecast Run	Spawning Escapement Target	Management Adjustment	Aboriginal Exemption	Test Fishing	Total Allowable Catch
Early Stuart	105,000	75,000	11,000	17,000	2,000	0
Early Summer	678,000	227,000	87,000	51,000	10,000	303,000
Summer	9,006,000	3,242,000	0	290,000	90,000	5,384,000
Late	3,577,000	2,892,000	0	42,000	15,000	628,000
Total	13,366,000	6,436,000	98,000	400,000	117,000	6,315,000

Goals for the domestic allocation of Fraser sockeye among Washington fishers were provided as follows:

1. Treaty Indian fishers would receive 69.0% of the United States TAC while Non-Indian fishers would receive 31.0% of the TAC;
2. Treaty Indian fishers in Areas 4B, 5 and 6C were allocated a minimum of 12.5% of the Treaty Indian share; and
3. Among the Non-Indian commercial gear types, allocation targets were 54% for purse seines, 41% for gillnets and 5% for reefnets.

Canadian catch goals included a total share of 5,728,000 fish at the 50% probability level forecast, and 3,174,000 fish at the 75% probability level forecast. The Canadian catch shares for both the 50% and 75% probability level forecasts were provided as follows: in-river First Nations 700,000 fish; marine First Nations 250,000 fish; in-river recreational 45,000 fish; and marine recreational 5,000 fish. The commercial catch share was 4,728,000 fish at the 50% probability level forecast and 2,174,000 fish at the 75% probability level forecast. In addition, DFO identified proportional sharing arrangements for Fraser sockeye for the commercial sector as follows: 37% for Area B purse seines; 14.5% for Area D gillnets; 28.5% for Area E gillnets; 8% for Area G trollers; and 12% for Area H trollers.

B. Pre-season Regulations

Panel discussions that commenced in April focussed on the development of an optimum management approach for the harvest of Summer-run sockeye that recognized conservation concerns for Late-run stocks.

The Fishery Simulation Model was run using the 50% and 75% probability level forecasts of abundance, the gross escapement targets, and the international and domestic allocation goals outlined above. During simulation modelling, DFO's forecasts of diversion rate via Johnstone Strait (Figure 3), and 50% arrival timing dates for the Early Stuart (to the lower Fraser) and Chilko runs (to Area 20) were not available. However, the diversion rate was expected to be low in 2002; therefore, a 25% diversion rate and average marine timing for all stocks were assumed. A precautionary approach was taken in modelling Late-run sockeye migration behaviour. The early upstream migration behaviour of these sockeye was expected to continue (no delay in the Strait of Georgia), resulting in a 90% en route and pre-spawning mortality. This enabled the Fraser River Panel to consider the potential loss of this number of spawners in the event that the magnitude of Late-run mortality prior to spawning was similar to recent past years. The simulation modelling focussed on harvesting Early Summer-run and Summer-run (mainly Quesnel) sockeye. Fishing restrictions were modelled early in the season to minimize harvest impacts on Early Stuart sockeye. In addition, a 15% exploitation rate limit on Late-run stocks was established in order to protect these stocks (Appendix G).

Results of simulation modelling of the fishery at the 50% probability level forecast showed that the majority of the Summer-run sockeye TAC could be harvested, despite constraints imposed by the conservation requirements for Early Summer-run and Late-run stocks, provided historical average timing separation occurred between the Summer-run and Late-run stocks. At the 75% probability level forecasts, the model indicated that the stocks could be harvested, even with timing overlaps; at lower abundance levels, optimal Summer-run exploitation rates would be lower.

The Commission provided guidance to the Panel and to the PSC staff on an improved Fraser River Panel process, in a June 12, 2002 Commission agreement (Appendix B). Subsequently, at a meeting on June 19-20, the Panel approved a 2002 Management Plan that incorporated the modelled conservation constraints on Early Summer-run and Late-run stocks.

In the agreed upon pre-season Management Plan (Appendix F), fisheries in United States Panel Area waters were anticipated to start during the week of July 21 – 27 in Areas 4B, 5 and 6C, and during the week of July 28 – August 3 in Areas 6, 7 and 7A using the 50% probability level forecast. Fisheries in all United States Panel Area waters were postponed by one week, and fishing times were reduced, at the 75% probability level forecast. Canadian Panel Area fisheries were expected to open during the week of July 28 – August 3 for Area B purse seiners, Area H trollers and Area E gillnetters at the 50% and the 75% probability level forecasts. Fishing times were reduced at the 75% probability level forecast.

During the pre-season planning process, the Parties identified a number of conservation and management concerns. The species and stocks that were identified as being of concern to Canada included Thompson River coho salmon, lower and upper Georgia Strait coho salmon, Johnstone Strait coho salmon and Summer-run chum salmon, Thompson River steelhead and west coast Vancouver Island and Harrison River chinook salmon. The species and stocks identified by the United States included Hood Canal summer-run chum salmon and Puget Sound chinook salmon.

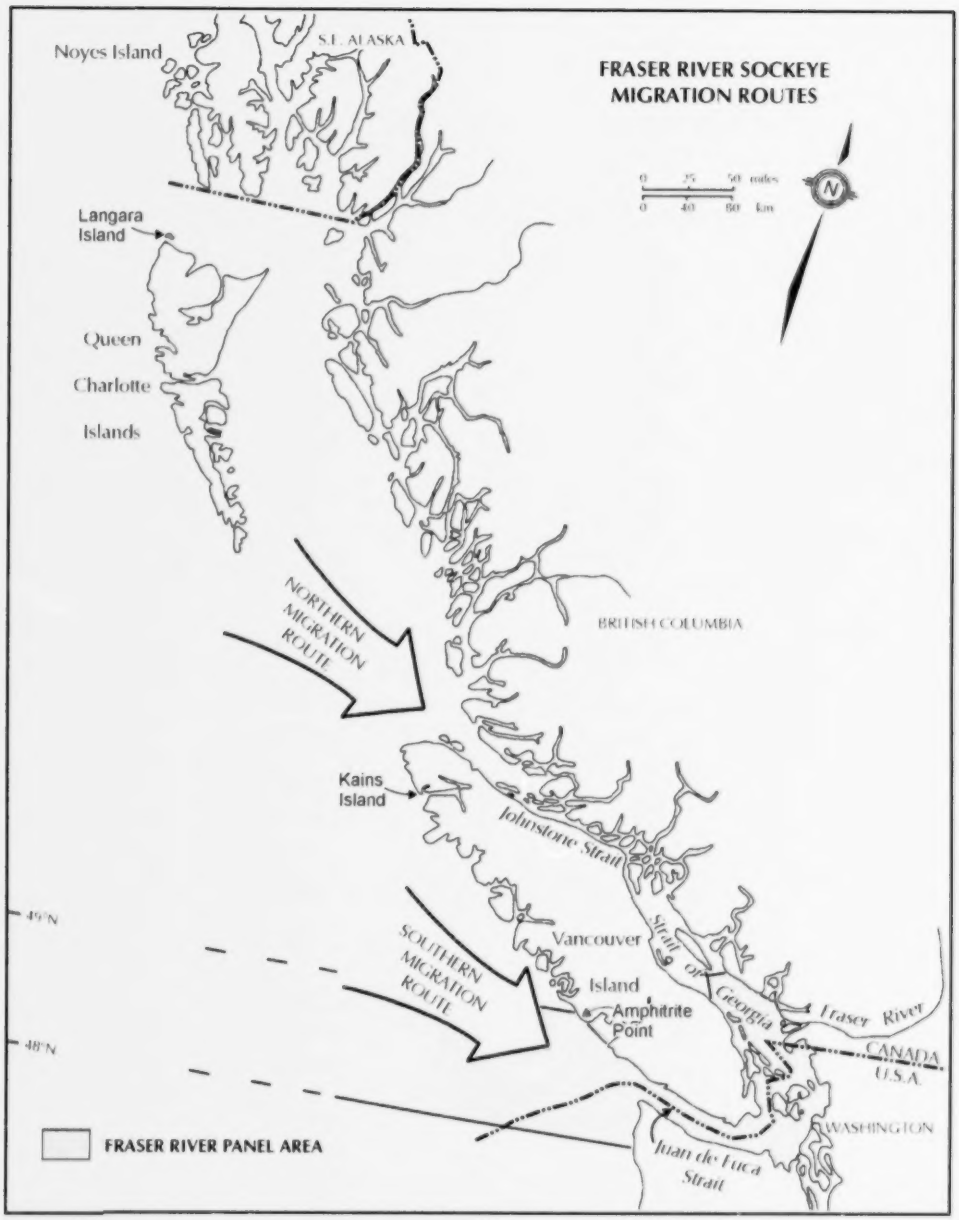

Figure 3. Fishery management areas and commercial gear used in the Fraser River Panel Area and Canadian south coast waters.

C. In-season Regulations

Between July 12 and September 17, the Fraser River Panel conferred 22 times (by telephone or in-person) to discuss the status of the Fraser sockeye runs and to enact in-season Orders (Appendix I) for the regulation of fisheries directed at the harvest of Fraser River sockeye salmon in Panel Areas.

The environmental conditions for sockeye salmon that migrated upstream of Mission in 2002 were generally favourable, with the exception that Fraser River discharge levels from late-June through mid-July were above normal and adversely affected sockeye migrating during this time period. A portion of the Late-run sockeye migration followed the migratory behaviour of recent years (1996 – 2001) and instead of delaying for an extended period (4 – 6 weeks) in the Strait of Georgia; they migrated directly into the Fraser River. However, the majority of Late-run sockeye delayed for a period of weeks, migrating into the Fraser River from September 11 – 20. Contrary to pre-season expectations, the high in-river mortality rates experienced by Late-run sockeye in recent years did not occur in 2002, and the estimated en route and pre-spawning mortality losses were low.

The main events of the 2002 fisheries management season are summarized on a weekly basis below. This synopsis focuses on analyses and recommendations by PSC staff, and on Panel decisions.

The first in-season meeting of the Panel took place on July 12. The Early Stuart run appeared to be returning at near-normal timing. Based on advice from staff, the Panel adopted an Early Stuart run size of 60,000 fish for management purposes. The escapement of Early Stuart sockeye past Mission was comprised of approximately 44% 4_2's, however, the poor 4_2 return was thought to be related to poor freshwater survival of Early Stuart juveniles, and was not anticipated to provide an indication of the probable return strength of later-timed stocks.

At a July 16 meeting the staff informed the Panel that the Early Stuart return would be close to the Panel-approved run size of 60,000 fish. While it was too early to provide a provisional run size update for Early Summer-run sockeye, the run appeared to be slightly late or weaker than the 50% probability level forecast. In addition, contrary to expectations, Summer-run sockeye had not been identified in marine-area scale samples, which indicated that this run-timing group was either late or not returning early. The status of the runs was basically unchanged on July 19, and staff advised the Panel that neither the marine abundance of Summer-run fish nor the Mission estimates for Early Summer-run or Summer-run sockeye were tracking at sufficient levels to provide Panel-area fishing opportunities. However, the Panel approved a low-harvest impact Treaty Indian drift gillnet fishery in Areas 4B, 5 and 6C. The rationale for the fishery included: the fishery would be directed at Summer-run sockeye; minimal harvest impact would be imposed on Early Summer-run sockeye; the fishery was not inconsistent with the pre-season management objectives of the Panel; and the fishery would provide information on sockeye migration in United States waters. PSC staff also reviewed rationale for the use of a fishery cut-off date (in approximately mid-August) to reduce the probability that the Late-run exploitation rate ceiling would be exceeded. The Panel did not reach a decision on this issue.

At the meeting on July 23, the staff reported that the accounted Early Stuart run was 62,000 fish, and that the run was virtually complete. The early-timed Early Summer-run component (not including the Seymour/Scotch stock-group) was tracking between the 50% and 75% probability level forecasts, while Summer-run sockeye would have to be approximately five days late to reach the 75% probability level forecast. The only Panel area fishery approved at the meeting was an extension of the Treaty Indian drift gillnet fishery in Areas 4B, 5 and 6C.

By July 26, the sockeye abundance in Area 20 was increasing, and scale analyses indicated that the proportion of age 4_2 sockeye was also increasing, consistent with the building Summer-run abundance. Staff assessments indicated that the early-timed Early Summer-run component was tracking at close to the 75% probability level forecast, while the Seymour/Scotch component was returning at levels closer to the 50% probability level forecast. The staff indicated that while there

was no TAC available at the 75% forecast level, problems would arise with subsequent Late-run harvest concerns if the Panel waited too long to initiate Summer-run directed fisheries. An option presented for the Panel's consideration was to delay the initiation of larger impact fisheries by approximately five days (relative to the pre-season plan), to compensate for the later than average Summer-run timing. No new Panel area fisheries were announced.

On July 29, the Panel approved a provisional run size of 160,000 fish (for management purposes) for the early-timed Early Summer-run component. The staff advised the Panel that the Seymour/Scotch component continued to track close to the 50% forecast level, and appeared to be approximately two days late. Estimates of Summer-run sockeye timing indicated that they were also late, and were tracking at the 75% forecast level. In response to the run size assessments, Canada announced that it would limit by-catches of Early Summer-run sockeye in Canadian commercial fisheries to a TAC consistent with a return of 450,000 fish. Canada also stated its intention to establish gross escapement targets consistent with this run size and to constrain fisheries to ensure Canada had Early Summer-run TAC available in future weeks. The United States noted that its fisheries would be conducted with consideration of the same rationale as those outlined by Canada. Taking these constraints into consideration, the Panel approved short-duration Canadian fisheries in Panel Area waters for Area B purse seines in Area 20, and for Area E gillnets in Area 29. In United States Panel Area waters, Treaty Indian fisheries were approved for drift gillnets in Areas 4B, 5 and 6C, and for net fishing in Areas 6, 7 and 7A.

On August 1, the PSC staff informed the Panel that Late-run sockeye had begun to arrive in migratory area waters. Their arrival was earlier than expected and provided the impetus for the United States to propose Panel water fisheries for Non-Indian user groups in anticipation that Late-run sockeye proportions would increase in the coming days. The Panel approved Non-Indian fisheries for purse seines and gillnets in Areas 7 and 7A. At a meeting on August 2 staff assessments indicated that the early-timed Early Summer-run sockeye continued to track at the 75% probability level forecast, with timing approximately two days late. The Seymour/Scotch stock- group was tracking between the 50% and 75% probability level forecasts, depending on whether normal or late timing was assumed. The Panel approved a run size for the Early Summer-run complex of 550,000 fish, with a best timing estimate of two days later than normal. While the staff recommended no change to the pre-season Summer-run run size, they reported to the Panel that the run was tracking between the 50% and 75% probability level forecasts. If the 75% probability level forecast was assumed for fishery planning purposes, there would be sufficient TAC to allow fisheries in the coming week. The staff also advised the Panel to use the 50% probability level forecast for the Late-run run size for fishery planning purposes. Both Canada and the United States proposed fisheries with the intention of constraining catches within their allowable TAC allocations for Summer-run and Late-run sockeye. In United States Panel Area waters, Treaty Indian fisheries were approved for drift gillnets in Areas 4B, 5 and 6C, and for net fishing in Areas 6, 7 and 7A. In addition, a Non-Indian reef net fishery was approved for Areas 7 and 7A. In Canadian Panel Area waters, fisheries were approved for Area H trollers in Area 18 and for Area E gillnets in Area 29, excluding sub-areas 29-1 to 6, to protect Late-run sockeye delaying in the Strait of Georgia.

At the August 5 Panel meeting the staff informed the Panel that the best estimate of the run size of Early Summer-run sockeye was still 550,000 fish, and that Summer-run sockeye continued to track between the 50% and 75% probability level forecasts with timing five days late. The staff also noted that recent DNA analyses confirmed that Late-run sockeye were migrating into the Fraser River. In addition, Cultus Lake sockeye had been observed migrating past the Sweltzer Creek enumeration fence starting on August 3, which was the earliest observed migration date on record. The Panel discussed the issue of whether early migrating Late-run sockeye were less likely to successfully spawn than later migrants, and whether their differential spawning viability should be considered in the formulation of the Panel's Late-run harvest policy. Canada stated that it would be considering this issue in domestic policy discussions.

At the August 6 meeting the Panel was informed that the run size of Early Summer-run sockeye would likely exceed 550,000 fish due to continued strength in the Seymour/Scotch stock-group. The decline in daily abundance of Summer-run sockeye in Area 20 was also noted, which raised concerns about the Summer-run run size. The Panel approved fisheries for United States

Panel Area waters that were structured so that the United States would stay within its available share of the Late-run TAC. The approved fisheries included a Treaty Indian drift gillnet fishery in Areas 4B, 5 and 6C, and short duration Non-Indian purse seine and gillnet fisheries in Areas 7 and 7A (southerly and easterly of the Iwersen's Dock Line). The Iwersen Dock Line fishing boundary was implemented to minimize the possibility of harvesting delaying Late-run sockeye.

By August 8 the daily abundance of sockeye had increased, particularly through the Johnstone Strait marine approach route. The Summer-run abundance was again tracking between the 50% and 75% probability level forecasts. Late-run model estimates ranged from 2,900,000 to 5,000,000 fish (excluding Birkenhead sockeye), with the estimates being highly dependent on the timing assumption used. While it was too early in the migration to accurately assess Late-run sockeye abundance, the staff reported that the run would likely exceed the 75% probability level forecast. Canada stated that the unusually early arrival of Late-run sockeye in marine approach areas was beyond the scope of the pre-season planning conducted by the Panel. Canada contended that Late-run sockeye that had already migrated past the marine approach areas would not survive to successfully spawn. Therefore, Canada suggested consideration that the 15% exploitation rate limit for Late-run stocks be applied only to the harvest of Late-run sockeye occurring after August 8, with the catch of Late-run sockeye taken to date not contributing to the 15% harvest limit. The intention of the policy change would be to balance the harvest objectives directed at Summer-run sockeye with conservation concerns for Late-run sockeye stocks. The United States suggested limiting the concept of discounting Late-run sockeye catches to in-river catches. They also suggested that consideration be given to the results of the 2001 Late-run terminal-area tagging studies conducted by DFO, in the establishment of a cut-off date. Canada agreed to consider the suggestion by the United States on the implementation details of the Late-run policy change.

During a review of marine area abundance and stock identification assessments on August 8, the staff concluded that the Summer-run abundance was nearing its peak in Area 12, and that Late-run proportions would likely increase. The Panel sought to balance the need for Summer-run harvest in conjunction with not exceeding the Late-run exploitation rate limit, given the uncertainty of the Late-run run size. At this meeting, the Panel adopted a run size for Early Summer-run sockeye of 700,000 fish, and a Summer-run run size of 8,000,000 fish with August 9 timing (Area 20 date) for management purposes. Staff assessments on Late-run sockeye ranged from 3,300,000 to 8,800,000 fish, with timing estimates spanning from August 9 to August 15 (Area 20 date). To be risk averse, the staff recommended that the Panel consider Late-run timing estimates ranging from two to four days later than the Summer-run peak for planning purposes. This resulted in Late-run run size estimates of 4,300,000 to 5,800,000 fish. However, the staff stated that the preliminary nature of the estimates precluded a formal recommendation of Late-run run size for the Panel's consideration. After discussion, the Panel adopted a revised management plan that incorporated an assumption that Late-run sockeye harvested in the Fraser River through August 17 (Mission date) would not be considered against the 15% exploitation rate limit. This date was predicated on the assumption that the terminal area survival-data from DFO's 2001 Late-run tagging studies could be applied to fish entering the lower river, with an appropriate time lag. The tagging data supported the assertion that Late-run sockeye migrating into the Fraser River through August 17 would be unlikely to spawn successfully. The Panel assumed a two-day separation in the peak timing of Summer-run and Late-run sockeye and established (without PSC staff recommendation) a run size for Late-run sockeye of 4,300,000 fish. Taking into consideration the revised policy on Late-run sockeye harvest, United States Panel Area fisheries were approved for Treaty Indian drift gillnets in Areas 4B, 5 and 6C, and for net fishing in Areas 6, 7 and 7A (southerly and easterly of the Iwersen's Dock Line). In addition, Non-Indian reef net and gillnet fisheries were approved for Areas 7 and 7A (southerly and easterly of the Iwersen Dock Line). In Canadian Panel Area waters, fisheries were approved for Area B purse seines in Area 20, for Area H trollers in Area 18 and for Area E gillnets in Area 29, excluding sub-areas 29-1 to 6 to protect Late-run sockeye delaying in the Strait of Georgia.

At a meeting on August 12, the Panel adopted run-sizes of 800,000 Early Summer-run sockeye, 7,000,000 Summer-run sockeye, and 4,000,000 Late-run sockeye (excluding Birkenhead sockeye). The Panel approved a fishery for Area E gillnets in Area 29, excluding sub-areas 29-1 to 6, to protect Late-run sockeye delaying in the Strait of Georgia, and to harvest Summer-run sockeye surplus to gross escapement requirements. On August 14, the staff reported that current

assessments indicated that the Johnstone Strait sockeye diversion rate was approximately 77%. Assessment data indicated that the number of Late-run sockeye delaying in the Strait of Georgia was approximately 550,000 fish. The staff informed the Panel that current data did not support Late-run sockeye (excluding Birkenhead) run-size estimates exceeding 4,400,000 fish and that the best estimate was unchanged at 4,000,000 fish. The staff noted that while there was TAC remaining for harvest, the Late-run racial proportion from the most recent Area 12 commercial purse seine fishery was 77%, and that from a staff perspective remaining harvest opportunities should be viewed within the context of their consistency with the pre-season plan. The Canadian position was that they would be guided by the 15% exploitation rate limit on Late-run sockeye, and Canada remained interested in pursuing small bite fisheries that did not exceed the exploitation rate limit.

At an August 16 Panel meeting, the Panel adopted run size estimates of 850,000 Early Summer-run and 6,000,000 Summer-run sockeye. The Summer-run estimate had declined from earlier estimates due to reduced Summer-run proportions in recent marine area DNA samples. Run size estimates for Late-run return ranged from 4,700,000 to 7,100,000 fish, depending on the model and timing assumptions used. The Panel accepted staff advice regarding a best Late-run timing estimate of August 12, and approved a run size estimate of 5,500,000 Late-run fish (excluding Birkenhead sockeye). Staff noted that there was high uncertainty regarding the abundance in the tail of the Late-run migration and that their abundance could exceed 5,500,000 fish if marine area test-fishing catches of Late-run sockeye remained high over the coming days. There was also high uncertainty in assessments of the number of Late-run sockeye delaying in the Strait of Georgia (estimated at 550,000 fish), and the number that were holding on the flats off the mouth of the Fraser River. It was assumed that early upstream migration of the delaying Late-run fish could still occur with high en route mortality. It was not possible to predict when the migration of delaying Late-run sockeye would occur, or how many of the delaying fish would successfully spawn. In response to a Panel question, the staff advised that gillnet fisheries could be conducted in United States waters within the context of the pre-season plan, but purse seine fisheries would result in a directed harvest of Late-run sockeye. Canada stated that while the pre-season plan stipulated no directed harvest of Late-run sockeye, the Panel was now managing outside the pre-season expectations. Canada noted that it was managing on the basis of the total allowable impacts on Late-run sockeye under the revised Panel agreement. Furthermore, in anticipation of a future Canadian harvest, Canada was not asking the United States to forego fisheries. The position of the United States on additional Late-run harvest was that their assessments indicated that Canada would likely exceed its Late-run harvest share, and that the United States did not feel it could proceed with fisheries without risking exceeding the bilateral Late-run exploitation rate limit. The situation was virtually the same on August 19, and therefore, no Panel Area fisheries were recommended.

On August 23, the staff reported that model estimates of Late-run sockeye abundance had increased in recent days due to the protracted migration pattern of the Late-run stocks. The Panel accepted a staff recommendation for a Late-run run size of 5,800,000 fish (excluding Birkenhead). The staff also noted that approximately 2,300,000 Late-run sockeye were now estimated to be delaying in the Strait of Georgia. An estimated 1,600,000 fish were holding in deep-water locations and 700,000 fish holding off the mouth of the Fraser River in shallow water. A revised Late-run TAC calculation was also reviewed, which reflected Canada's understanding of the August 9, Late-run exploitation rate agreement. The revised TAC calculation was approved and it provided additional fish for Late-run harvest, resulting in the Panel approving a United States Non-Indian gillnet fishery in Areas 7 and 7A (southerly and easterly of the Iwersen's Dock Line). The rationale for the fishery was that the United States was well below its TAC on Late-run sockeye, and the fishery would be targeting Summer-run sockeye, which were surplus to gross escapement requirements. The staff also asked for a Panel decision on implementing a fishery cut-off date, as was anticipated in the pre-season plan. The Panel stated that the cut-off date was contemplated to control Late-run sockeye impacts in the absence of in-season run-size updates. Since in-season updates were now available on both Late-run timing and abundance, the need for a cut-off date to protect against the over harvest of Late-run sockeye was not required.

At the August 25 meeting, the staff reported that purse seine test fishing catches had remained

high in Johnstone Strait. Late-run assessment models were projecting lower than expected run sizes due to an unusually protracted Late-run migration pattern, along with observed multiple peaks in daily abundance. Model estimates ranged from 5,300,000 to 6,000,000 fish, depending on the timing and distribution assumptions used. The staff concluded that based on current data, they could not support a recommendation to increase the Late-run run size above the current estimate of 5,800,000 fish. However, in response to Panel questions, the staff also noted that there was a high degree of uncertainty in the Late-run estimate. Accounting-based estimates for Early Summer-run and Summer-run sockeye resulted in the Panel adopting increased run sizes for these run timing-groups of 880,000 fish and 6,200,000 fish, respectively. Staff assessments indicated there were now approximately 2,700,000 Late-run sockeye delaying in the Strait of Georgia. Independent data collected from the Late-run marine tagging program indicated that 60% of the Late-run sockeye were delaying, with 40% migrating upstream. While the early upstream migration behaviour of Late-run sockeye was not as extreme as in 2000 and 2001, significant mortality could still be expected on the Late-run sockeye that had migrated past Mission to date. The United States announced that they would not be contemplating additional fisheries for the balance of the season because additional fishing at this late stage of the run was inconsistent with the pre-season plan.

On August 27, the staff reported that the Summer-run and Late-run returns to date, including the Late-run fish delaying in the Strait of Georgia, and fish migrating between marine assessment areas and Mission, indicated that the run size for both groups was larger than expected. Based on the continued abundance of fish in the Johnstone Strait test fisheries, and a projection of the number of fish remaining to come, the Panel accepted staff recommendations for a Summer-run and Late-run run sizes of 6,700,000 fish and 6,500,000 fish, respectively. It was also estimated that to date, approximately 60% of Late-run sockeye were delaying in the Strait of Georgia. However, historical relationships indicated that if the overall 50% upstream migration date occurred prior to mid-September the in-river mortality could still exceed 50%. The United States reiterated their earlier position, that they were not contemplating additional fishing due to inconsistencies with the pre-season plan. Canada took a different viewpoint, stating that additional fisheries were warranted under the current fisheries management plan provided they were consistent with the 15% exploitation rate limit for Late-run sockeye. However, no Panel Area fisheries were proposed.

Run size assessments were unchanged at the August 30 Panel meeting. In response to a question from the United States section, Mr. Saito noted that after the cessation of all future fisheries, including in-river First Nations fisheries, Canada expected to be close to its share of the Late-run catch allocation. The United States noted that it was not fishing up to its maximum allowable allocation on Late-run sockeye to allow for additional spawning escapement, and did not wish to transfer any of their unharvested share to Canada.

By September 6, approximately 49% of the estimated Late-run sockeye abundance in the marine terminal areas had migrated upstream. For comparison purposes, staff noted that by September 6, 22% had migrated upstream in 1998 resulting in a 35% combined en route and pre-spawning mortality, and in 1999, 39% had migrated upstream by September 6, with a 65% combined en route and pre-spawning mortality.

On September 17, staff informed the Panel that a large escapement of approximately 2,400,000 Late-run sockeye had occurred in the preceding four days, with an additional 1,600,000 fish estimated to be remaining in the Strait of Georgia. Indications of potential overestimation bias in recent hydroacoustic estimates at Mission were also evident, largely due to sockeye milling behaviour. The staff reviewed the Late-run accounting to date, which included estimated numbers of fish holding in the Strait of Georgia. Staff also took into account the milling behaviour at Mission. Staff recommended that the run size of Late-run sockeye be increased by approximately 1,000,000 fish. After accounting-based reviews for co-migrating stocks, the Panel approved the following run size estimates: 6,800,000 Summer-run, 300,000 Birkenhead, and 7,500,000 Late-run fish. The staff also reported that the current estimate of the 50% upstream passage date for Late-run sockeye was September 9, the fifth earliest date since 1995. Based on data from recent past years, staff projected that the potential Late-run en route mortality due to early upstream migration

would likely be in the 40% to 80% range. No Panel area fisheries were proposed in response to the staff update.

On September 25, the staff reported that all in-season assessment programs had been terminated, with the exception of the Late-run tagging assessment work. The Panel was apprised of a correction to the Mission hydroacoustic estimates that were made in September, to correct for the sockeye milling behaviour identified earlier in the month. The corrected Mission escapement estimates were 6,400,000 Summer-run sockeye, 300,000 Birkenhead sockeye, and 7,500,000 Late-run sockeye. The Panel accepted the revisions, subject to a post-season review of the data by the staff and the FRPTC.

Regulatory control in Fraser River Panel waters was relinquished as per the pre-season schedule.

Weekending dates when Canadian Panel Area waters were open for sockeye retention are shown in Table 2. No gillnet fishing was scheduled in Area 20 due to coho conservation concerns. One-day purse seine fisheries were scheduled in Area 20 for international and domestic sockeye allocation purposes during the weeks of July 28 – August 3 and August 11 – 17. These fisheries were closely monitored by DFO to control coho and chinook salmon encounters. Four days of fishing were scheduled for gillnet fisheries in Area 29 for international and domestic sockeye allocation purposes. These fisheries were restricted area openings to prevent harvest of Late-run sockeye. Area H troll fisheries were scheduled in Area 18 for periods of one day during the week of July 28 to August 3, three days during the week of August 4 to 10, and one day during the week of August 11 to 17. Canada regulated commercial fisheries in non-Panel Area waters in coordination with Panel management.

Table 2. Actual fishing times (days) in major Canadian fisheries in the Fraser River Panel Area in 2002.

	Area 20		Area 29	Areas 18, 29
Date	Purse Seine	Gillnet	Gillnet	Troll
Jun.23-Jul.20	Closed	Closed	Closed	Closed
Jul.21-Jul.27	Closed	Closed	Closed	Closed
Jul.28-Aug.3	1 *1*	Closed	1 *2*	1 *3*
Aug.4-Aug.10	Closed	Closed	1 *2*	3 *3*
Aug.11-Aug.17	1 *1*	Closed	2 *2*	1 *3*
Aug.18-Aug.24	Closed	Closed	Closed	Closed
Aug.25-Aug.31	Closed	Closed	Closed	Closed
Sep.1-Sep.7	Reling.	Reling.	Closed	Closed
Sep.8-Sep.14			Closed	Closed
Sep.15-Sep.21			Closed	Closed
Sep.22-Sep.28			Closed	Reling. *4*
Sep.29-Oct.5			Closed	Closed
Oct.6-Oct.12			Reling.	Reling. *5*
Oct.13-Oct.19				
Total	2	0	4	5

1 On-ground controls implemented by DFO.
2 Short-duration finsheries.
3 Area 18 only.
4 Regulatory control in Area 18 relinquished on September 28.
5 Regulatory control in Area 29 relinquished on October 12.

Net fishing times in United States Panel Areas are shown in Table 3. These fisheries were conducted to meet the international and domestic allocation obligations of the Panel. The Treaty Indian fishery in Areas 4B, 5 and 6C was open for a total of 426 hours during the period from July 21 to August 12. The Treaty Indian fishery in Areas 6, 7 and 7A was open for 33 hours during the week of July 28 to August 3, and for 12 hours on August 11. Non-Indian gillnet fisheries in Areas 7 and 7A were open a total of 50 hours spanning a five week period. Non-Indian purse seines had seven hours of sockeye fishing including a six-hour fishery on August 2 and a one-hour fishery on August 8. Non-Indian reefnets had a total of 64 hours of sockeye fishing spanning the weeks of July 28 to August 3 and August 4 to 10.

Table 3. Actual fishing times (hours) in major United States net fisheries in the Fraser River Panel Area in 2002.

	Treaty Indian		Non-Indian		
	Areas	Areas	Areas 7 and 7A		
Date	4B, 5, 6C	6, 7, 7A	Purse Seine	Gillnet	Reefnet
Jun.23-Jul.20	Closed	Closed	Closed	Closed	Closed
Jul.21-Jul.27	144	Closed	Closed	Closed	Closed
Jul.28-Aug.3	104	33	6	6	16
Aug.4-Aug.10	136	Closed	1 *1*	4 *1*	48
Aug.11-Aug.17	42	12 *1*	Closed	4 *1*	Closed
Aug.18-Aug.24	Closed	Closed	Closed	12 *1*	Closed
Aug.25-Aug.31	Closed	Closed	Closed	24 *1*	Closed
Sep.1-Sep.7	Relinq.	Closed	Closed	Closed	Closed
Sep.8-Sep.14		Relinq.	Relinq.	Relinq.	Relinq.
Sep.15-Sep.21					
Total	426	45	7	50	64

1 Iwersen's Dock Line in effect.

V. CATCH SUMMARY

The total return in 2002 of 15,137,000 Fraser River sockeye salmon (Table 4) was 13% above the pre-season run-size 50% probability level forecast (13,366,000 fish), and 91% above the 75% probability level forecast (7,911,000 fish). In the previous 12 returns on the 2002 cycle line (1954 to 1998), sockeye abundance has ranged from a low of 3,512,000 fish (1962) to a high of 21,984,000 fish (1990). The 2002 return was the fifth highest return dating back to 1954, and was above the long-term cycle-average of 12,018,000 fish (Figure 4). The commercial exploitation rate (20.0%) was the lowest for this cycle over the period of record (i.e., since 1954).

Catches of Fraser River sockeye salmon in all fisheries totalled 4,223,000 fish (Table 4). Canadian catches of 3,617,000 sockeye included a commercial harvest of 2,143,000 fish, a selective fishery catch of 75,000 fish, a First Nation's catch of 1,155,000 fish, an ESSR catch of 9,000 fish, a Weaver Channel surplus harvest of 100,000 fish and miscellaneous non-commercial catches of 135,000 sockeye. United States' fishers caught 450,000 fish, including a commercial harvest of 435,000 sockeye and a ceremonial and subsistence catch of 15,000 fish. In addition to the catches outlined above, test fisheries authorized by the Fraser River Panel landed 156,000 sockeye.

Table 4. Preliminary estimates of fishery catches, spawning escapement and total run of Fraser River sockeye salmon during the 2002 fishing season, by country and area.

	Number of Fish	% of Run
CANADA		
COMMERCIAL CATCH		
Fraser River Panel Area		
Areas 121-124 Troll	111,000	
Area 20 Net	226,000	
Areas 17-18 and 29 Troll	17,000	
Area 29 Net	950,000	
Total	1,304,000	8.6%
Non-Panel Areas		
Areas 1-10 Troll and Net	0	
Areas 11-16 Troll and Net	796,000	
Areas 124-127 Troll	43,000	
Total	839,000	5.5%
Selective Fisheries	75,000	0.5%
Commercial Total	2,218,000	14.7%
FIRST NATIONS CATCH		
Marine Areas - food, social, ceremonial		
Areas 12-16, 18, 20, and 123-126	252,000	
Area 29-1 to 7	13,000	
Total	265,000	1.8%
Fraser River - food, social, ceremonial		
Below Sawmill Creek	556,000	
Above Sawmill Creek	214,000	
Total	770,000	5.1%
Pilot Sales	120,000	0.8%
First Nations Total	1,155,000	7.6%
NON-COMMERCIAL CATCH		
ESSR *	9,000	
Weaver Channel Surplus Harvest	100,000	
Charter	7,000	
Recreational - Marine	5,000	
Recreational - Fraser R.	123,000	
Non-Commercial Total	244,000	1.6%
CANADIAN TOTAL	3,617,000	23.9%
UNITED STATES		
COMMERCIAL CATCH		
Fraser River Panel Area		
Areas 4B, 5 and 6C Net	44,000	
Areas 6 and 7 Net	180,000	
Area 7A Net	210,000	
Total	434,000	2.9%
Non-Panel Areas		
Alaska Net	1,000	0.0%
Commercial Total	435,000	2.9%
NON-COMMERCIAL CATCH		
Ceremonial & Subsistence	15,000	0.1%
UNITED STATES TOTAL	450,000	3.0%
TEST FISHING		
COMMISSION		
Areas 20 and 29	141,000	
Area 7	0	
Commission Total	141,000	0.9%
CANADA		
Areas 12 and 13	15,000	0.1%
TEST FISHING TOTAL	156,000	1.0%
TOTAL CATCH	4,223,000	27.9%
SPAWNING ESCAPEMENT (includes 5,400 jacks) **	10,206,000	67.4%
DIFFERENCE BETWEEN ESTIMATES ***	708,000	4.7%
TOTAL RUN	15,137,000	100.0%

* Harvest of Weaver sockeye in terminal areas that were Excess Salmon to Spawning Requirements (ESSR).

** DFO enumerations plus PSC projected escapement for populations that were not enumerated.

*** [Mission escapement + First Nations catch below Mission] - [total Fraser River First Nations catch, in-river recreational catch & spawning escapement], for Late-run stocks.

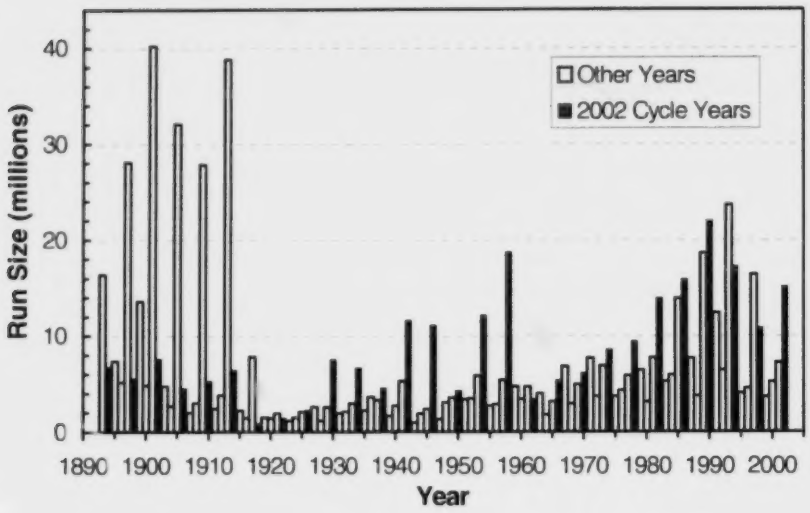

Figure 4. Total run sizes of Fraser River sockeye salmon between 1893-2002. Returns on the 2002 cycle are emphasized.

A. Canada

The commercial catch in Canada was 2,218,000 fish, including 1,304,000 fish in Panel Areas and 839,000 fish in non-Panel Areas, while the selective fishery catch was 67,000 fish in Panel Areas and 8,000 fish in non-Panel Areas. Non-commercial catches included DFO charter catches of 7,000 fish, an ESSR catch of 9,000 fish and a recreational catch of 123,000 fish in the Fraser River.

Preliminary estimates of Canadian commercial catches of Fraser River sockeye salmon by gear type and area are presented in Table 5. Area B (southern) purse seines caught 738,000 sockeye (33% of the Canadian commercial catch), Area D (Johnstone Strait) gillnets caught 243,000 sockeye (11% of the commercial harvest) and Area E (Fraser River) gillnets caught 950,000 (43% of the commercial share). Within the troll gear sector, Area G (outside) trollers caught 155,000 sockeye (7% of the commercial harvest), and Area H (inside) trollers caught 132,000 sockeye (6% of the commercial share). Weekly catches in Canadian fishing areas are shown in Appendix J (Tables 1-4). Selective fishery catches totalled 55,000 by Area B (southern) purse seines, 7,000 by Area D gillnets, 1,000 by Area G trollers and 12,000 by Area H trollers.

First Nations fishers caught 1,155,000 sockeye, including 265,000 fish harvested in marine fisheries and 862,000 fish in the Fraser River (Appendix J, Table 5). The catch distribution in the Fraser River was as follows: 246,000 fish in the Fraser River below Mission; 431,000 fish harvested in the Fraser River between Mission and Sawmill Creek; and 214,000 fish in the mainstem of the Fraser River and in tributaries upstream of Sawmill Creek. Pilot sales fisheries accounted for 120,000 of the catch below Sawmill Creek.

Table 5. Preliminary estimates of Canadian commercial catches of Fraser River sockeye salmon by gear type, license designation and statistical area during the 2002 fishing season. *

	Purse Seine		Gillnet			Troll			
Areas	Area A	Area B	Area C	Area D	Area E	Area F	Area G	Area H	Total
1-10	0		0			0			0
11-16		457,000		236,000	0		0	103,000	796,000
121-127		0		0			154,000		154,000
20		226,000			0		0		226,000
17, 18, 29		0			950,000			17,000	967,000
Selective	0	55,000	0	7,000	0	0	1,000	12,000	75,000
Total Catch	0	738,000	0	243,000	950,000	0	155,000	132,000	2,218,000
% of Catch	0.0%	33.3%	0.0%	11.0%	42.8%	0.0%	7.0%	6.0%	100.0%

* DFO preliminary post-season catch estimates.

B. United States

Catches of Fraser River sockeye in the United States totalled 450,000 fish in 2002, 434,000 fish in Panel Area commercial fisheries and 15,000 fish in ceremonial and subsistence fisheries (Table 6). Treaty Indian fishers harvested 298,000 fish in commercial fisheries, including a catch of 44,000 fish in Areas 4B, 5 and 6C, and 254,000 fish in Areas 6, 7 and 7A. Non-Indian catches totalled 136,000 sockeye, including 75,000 fish by purse seines, 43,000 fish by gillnets and 18,000 sockeye by reefnets. Weekly catches of Fraser River sockeye salmon in United States Panel Areas are shown in Appendix J (Table 6).

Table 6. Preliminary estimates of United States commercial catches of Fraser River sockeye salmon by user group, gear type and statistical area during the 2002 fishing season. *

Areas	Ceremonial & Subsistence	Purse Seine	Gillnet	Reefnet	Total
Treaty Indian					
4B, 5 and 6C	0	0	44,000	0	44,000
6 and 7	0	86,000	26,000	0	112,000
7A	15,000	72,000	70,000	0	157,000
6, 7 and 7A Total	15,000	158,000	96,000	0	269,000
% of Catch	5.6%	58.7%	35.7%	0.0%	100.0%
Total Catch	15,000	158,000	140,000	0	313,000
% of Catch	4.8%	50.5%	44.7%	0.0%	100.0%
Non-Indian					
7	0	40,000	10,000	18,000	68,000
7A	0	35,000	33,000	0	68,000
Total Catch	0	75,000	43,000	18,000	136,000
% of Catch	0.0%	55.1%	31.6%	13.2%	100.0%
United States					
Panel Area Total	15,000	233,000	183,000	18,000	449,000
Alaska (District 104) Catch					1,000
Total Catch					450,000

* Washington catches from Washington Department of Fish and Wildlife "soft system".

VI. STOCK MONITORING

The goal of the stock-monitoring program is to assess run size, daily abundance, timing and diversion rate of Fraser River sockeye salmon at different points along their migration route. This information is required for the development of fishing plans that aid in meeting escapement and catch allocation objectives for Fraser River sockeye. Commercial catches usually provide much of the data used in the analyses. In addition, test fisheries (Table 7) conducted by the Commission or by DFO (at the Commission's request) provide important data before and after the commercial fishing season and between fishing periods. Information about upstream migration in the Fraser River was primarily obtained by the hydroacoustic (echosounding) program at Mission, B.C., visual observations at Hell's Gate and analysis of catches in Fraser River First Nations' fisheries.

The upstream passage of sockeye in 2002 was monitored using test fishing data collected at Whonnock from June 24 to July 12, and from Mission hydroacoustic data from July 13 to September 24. Estimates of daily sockeye escapements were calculated by applying species composition data collected from gillnet test fishing at Whonnock to the Mission hydroacoustic estimates. In addition, the PSC and DFO conducted an experimental split-beam hydroacoustic study for the eighth consecutive year.

Daily observations at Hell's Gate between July 2 and October 2 provided qualitative information on the success of upstream sockeye passage. The observations also provided a rough index for projecting the relative abundance of sockeye migrating through Hell's Gate.

Table 7. Test fishing operations that were approved by the Fraser River Panel for the 2002 fishing season.

Area	Gear	Dates	Operated by
		Canadian Panel Areas	
20	Purse Seine	July 22 - August 30	PSC
20	Gillnet	June 24 - August 6	PSC
29-13	Gillnet	July 13 - September 21	PSC
29-16	Gillnet	June 21 - September 24	PSC
29-1 to 6	Troll	August 7 - September 13	PSC
		Canadian non-Panel Areas	
12	Gillnet	July 10 - August 6	DFO
12	Purse Seine	July 21 - August 30	DFO
13	Purse Seine	July 21 - September 4	DFO
		United States Panel Areas	
7	Reefnet	July 21 - August 27	PSC

A. In-season Run-Size Estimates

Run-size estimation of Fraser River sockeye by stock group is primarily based on catch, effort, escapement, racial composition, timing, and diversion rate data. These data are analysed using purse seine catch, catch-per-unit-effort (CPUE) and cumulative-normal and cumulative-passage-to-date models, which are described in the Pacific Salmon Commission's Technical Report No. 6[3] and in the Fraser River Panel's 1995 Annual Report[4]. Much of the data used in these models require data from commercial fisheries; however, in 2002 there were few commercial fisheries, and therefore, test fishing catch and CPUE data were used more extensively than normal for assessments.

Early Stuart sockeye are the first Fraser River sockeye run arriving in coastal waters off British Columbia. Lower than expected numbers of Early Stuart sockeye catches in the Area 20 gillnet test fishery in late June suggested that the run was either smaller than the 50% p level forecast (105,000) or later than the forecast return timing of June 30 in Area 20. Analyses on July 2 and 5 indicated that the migration was tracking below the 75% pre-season forecast (59,000 fish). By July 9, an increase in abundance in the marine test fisheries was indicated and run-size estimates increased to between 45,000 and 60,000 fish. Based on these assessments, a run-size estimate of 60,000 Early Stuart sockeye was adopted on July 12. The 50% migration date of Early Stuart sockeye through Area 20 was estimated to have occurred on July 4 (one day later than normal). The final in-season estimates of Early Stuart abundance and gross escapement past Mission were 62,000 and 61,000 fish, respectively.

Later in July and early in August, management efforts focused on Early Summer-run sockeye; the later-timed Scotch/Seymour component comprised 65% of the pre-season forecast of this run. The assessment of the Early Summer-run abundance was based on examination of the early-timed component independent of the Scotch/Seymour group. On July 26, the early-timed component was tracking between the 75% and 50% p level forecasts, with July 21 peak timing in Area 20. On July 29, the Panel downgraded the early-timed component of Early Summer-run sockeye to 160,000 fish; while the Scotch/Seymour group and the total Early Summer-run abundance was unchanged. On August 2, the early-timed component was estimated at approximately 150,000 fish with timing two days earlier than forecast. The Scotch/Seymour component appeared to be tracking between the 75% and 50% p level forecasts depending on timing assumptions, with run-size estimates ranging between 350,000 and 490,000 fish. The Panel approved a run-size estimate of 550,000 Early Summer-run sockeye. By August 6, sustained abundance of Scotch/Seymour sockeye in marine areas and the Fraser River was evident, and run-size estimates exceeded 550,000 fish. Between August 9 and 16, the run-size estimate for Early Summer-run sockeye increased from 700,000 to 850,000 fish. The 50% migration point through Area 20 was estimated to have occurred on July 30 (two days later than expected). The final in-season estimates of Early Summer-run abundance and gross escapement past Mission were 900,000 and 647,000 fish, respectively.

The assessment of Summer-run sockeye abundance in 2002 was based primarily on projections of abundance through the test fisheries and on the reconstruction of catches and escapements past Mission (cumulative-normal, cumulative-passage and Bayesian models) rather than on commercial catch and effort models. In late July, the abundance of Summer-run sockeye was tracking between the 75% (5,204,000 fish) and 50% (9,006,000 fish) p level forecasts of abundance with 50 % arrival timing in Area 20 of August 8. On August 6, there was concern over the abundance of Summer-run sockeye, with estimates indicating between 4,200,000 and 7,200,000 sockeye depending on timing assumptions. On August 9, model estimates ranged between 7,700,000 and 9,100,000 fish and the Panel approved a run-size estimate of 8,000,000 fish. Continuing weakness in the migration of Summer-run through marine assessment areas

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[3] Pacific Salmon Commission. 1995. Pacific Salmon Commission run-size estimation procedures: An analysis of the 1994 shortfall in escapement of Late-run Fraser River sockeye salmon. Pacific Salmon Comm. Tech. Rep. No. 6: 179 p.

[4] Pacific Salmon Commission. 1998. Report of the Fraser River Panel to the Pacific Salmon Commission on the 1995 Fraser River sockeye and pink salmon fishing season. Vancouver, B.C., 64 p.

prompted the Panel to lower the run-size to 7,000,000 and to 6,000,000 fish on August 12 and 16, respectively. The run-size estimate was raised to 6,200,000 fish on August 25, and then to 6,700,000 fish on August 27, as late-season accounting resulted in estimates of higher abundance. By the end of the season, Summer-run sockeye abundance was estimated at 6,604,000 fish with a gross escapement of 4,917,000 fish. The estimated 50% migration date of Summer-run sockeye through Area 20 was August 8, approximately 4 days later than the long-term average timing (August 4) and near the forecast timing for Chilko sockeye (August 9).

Late-run sockeye were first identified in the marine assessment areas during the last week of July, indicating either greater overlap with co-migrating Summer-run sockeye and/or larger than forecast abundance of Late-run sockeye. Estimates of Late-run sockeye abundance on August 8 ranged between 2,900,000 and 5,000,000 fish, and on August 9 they ranged between 4,300,000 and 5,800,000 fish. These estimates were considered highly uncertain as they were based on preliminary data and timing assumptions. On August 9 the Panel adopted a provisional estimate of 4,300,000 Late-run sockeye (excluding Birkenhead). Continued strong abundance of Late-run sockeye migrating through Johnstone Straits was detected in the test fisheries. The Panel increased the run-size estimate for Late-run sockeye as follows: 5,500,000 fish on August 16, 5,800,000 fish on August 23, and 6,500,000 fish on August 27.

The Area 29 troll test fishery in the Strait of Georgia during August and September indicated that a greater proportion of Late-run sockeye were delaying in the Strait of Georgia than in recent years. Furthermore, CPUE data from this test fishery indicated Late-run sockeye abundance in the Strait of Georgia that was consistent with information from purse seine test fisheries in the Juan de Fuca and Johnstone Strait approaches. However, a larger than expected abundance of sockeye was observed at Mission during September relative to estimates in the Strait of Georgia. Interpretation of the results from the single-beam echosounding program was difficult, in part due to the very high abundance, but also due to the phenomenon of "sockeye milling" in the lower river at Mission. Errors in estimates by the single-beam program in September due to the "milling" problem were adjusted using data from the split-beam hydroacoustic program. The larger than expected Late-run abundance observed at Mission in September resulted in a higher final in-season estimate of total return, with an accounting estimate (including Birkenhead) of 7,750,000 fish and a gross escapement of 6,627,000 fish. The 50% migration date of Late-run sockeye through Area 20 was estimated to be August 13, approximately 7 days earlier than the cycle average.

Through the first week of August, the estimated proportion of sockeye migrating via Johnstone Strait was less than 10%. The estimated diversion rate increased to 75% for the remainder of August. The average diversion rate for the season was estimated at 51%, which was almost double the forecast of 27%.

Cottonwood test fishing CPUE's were plotted against the daily hydroacoustic estimates of sockeye passage at Mission in Figure 5. Cottonwood data are lagged one day during the Summer-run migration period and two days commencing September 1, during the Late-run migration period. These are the estimated travel times for sockeye between the Cottonwood and Mission sites.

Observations at Hell's Gate indicated that sockeye appeared to have migrated normally in 2002. However, the discharge of the Fraser River at Hope was approximately 9,500 cms at the beginning of July, which would have hindered the upstream migration of some Early Stuart sockeye. The discharge of the Fraser River at Hope generally exceeded 7,000 cms until approximately mid July. After this time, discharge rates decreased to near normal levels.

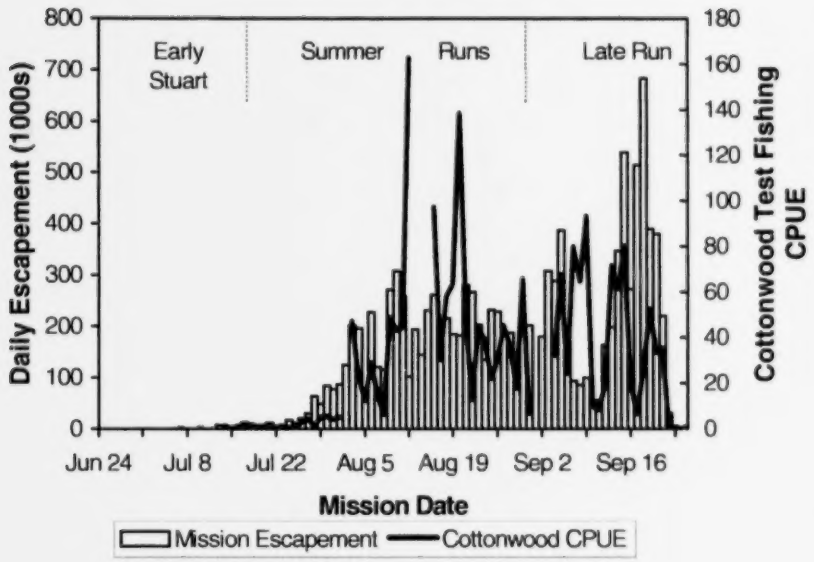

Figure 5. Daily Mission escapements of sockeye salmon estimated by Mission echosounding (after July 12) and Whonnock test fishing CPUE (June 24 to July 12), compared with test fishing CPUE's at Cottonwood one to two days earlier.

B. Split-Beam Hydroacoustic Study at Mission

The 2002 split-beam hydroacoustic program was examined to evaluate its utility as an in-season estimator of Fraser River sockeye salmon migrating past Mission. The program emerged as a result of cooperative research and development effort by the PSC and DFO that has been conducted since 1995.

The cross-section of the Fraser River was sampled primarily by a south-shore-based, side-looking system and a vessel-based downward-looking mobile system. A river-section approximately 60 meters off the north bank was periodically sampled by another side-looking system deployed from a vessel tied to the shore. A fish-deflection fence was installed at the south-bank sounding site to prevent acoustical blanking or blinding effects by fish migrating in the near - field or behind the transducers. This deflection fence helped to facilitate collecting adequate numbers of echoes for the system that allowed tracking of individual fish.

The following is a summary of the performance and some of the main findings of the 2002 split-beam program. The split-beam hydroacoustic system:

1. Estimated daily migratory abundance of Early Summer-run and Summer-run sockeye stocks at density-levels observed at Mission in 2002. Summer-run sockeye exhibited normal upstream migratory behavior in terms of their cross-river distribution, speed, and direction of travel.
2. Provided effective sampling of abnormally-distributed fish passages observed during the high-tide hours of 20:00-21:00 of August 20, 2002 when the majority of the migratory fish appeared two to three meters below the surface.

3. Promptly detected the milling behaviour of Late-run fish observed in mid-September. The radio-tagged fish tracked at Mission by LGL Limited during the same time period confirmed the milling behaviour observed by the split-beam system.
4. Was partially saturated during the hours of intense milling behavior at approximately 20:00 on September 14, 2002, which hindered the accurate resolution of individual targets. However, this temporary saturation of targets did not prevent the system from operating. The system retained a reasonable level of accuracy in resolving much of the migration of Late-run sockeye.
5. Provided fishery managers with timely and quantitative information on the milling behaviour of Late-run sockeye and its potential effects on the single-beam estimates of these stocks past Mission.

Analysis of the 2002 split-beam transecting data indicated that a 30-degree wide beam was not suitable for measuring fish speed because the inherent bias from positioning tended to underestimate fish speed. A hybrid flux model is being tested for the mobile split-beam system. This model utilizes the density data acquired from the 30-degree beam transducer but uses data from either shore-based systems or stationary soundings by the mobile split-beam system to evaluate fish speed and direction of travel. Post-season analyses include development of spatial statistical models for estimating fish flux in surface and bottom areas where the sound-beam could not sample effectively.

VII. RACIAL IDENTIFICATION

PSC staff conduct programs designed to identify the stock proportions of Fraser River sockeye in commercial, test and First Nations' catches. These data provide information on the abundance and timing of sockeye stocks as they migrate to their natal rivers in the Fraser River watershed. Racial data are also used to account for Fraser River sockeye salmon wherever they may be caught, and to apportion the daily estimates of sockeye escapement past Mission into discrete stock groups.

Racial analysis methods in 2002 were similar to past years except that tissue samples for DNA analysis were collected regularly from marine, river, and test fisheries. Both scale and DNA data were analyzed to generate racial composition estimates. However, due to an overlap in scale characteristics, DNA analyses were primarily used for management decisions. In addition, limited parasite analyses were conducted, mainly to verify the DNA-based estimates.

Analyses of scale samples from catch in commercial and test fisheries were conducted daily, beginning in late June and continuing through mid-September. Commission staff sampled test fishing catches and commercial sockeye landings at sites in Vancouver, Steveston, Port Renfrew, Campbell River, Ucluelet, and Port Hardy, British Columbia and at Bellingham and Blaine in the state of Washington. The Alaska Department of Fish and Game (ADF&G) collected samples for the PSC from the District 104 purse seine fishery at landing sites in Petersburg and Ketchikan, Alaska. DFO provided samples to the PSC from Johnstone Strait purse seine test-fisheries. In addition, the PSC requested that DFO and First Nations' personnel coordinate weekly scale sampling of Fraser River First Nations' fisheries from six regions along the Fraser River between Chilliwack and Prince George.

Tissue samples for DNA analysis were collected and analyzed from over 9,000 sockeye from test and commercial fisheries in Areas 12, 13, 20 and 29, with most of the samples collected in August. In-season DNA sampling was increased above the level planned pre-season due to the high demand for accurate data to help achieve the Panel's management goals. The collection of scale, tissue and parasite samples from the same fish (i.e., matched samples) allowed comparison of the different racial analysis methods.

A. Analyses

In 2002, the pre-season forecasts indicated that the most abundant stocks and/or stock groups would be Quesnel and Lower Adams. These stocks, along with less abundant stocks, were combined to form seven stock groups on the basis of identifiability and run timing: Early Stuart, Fennell/Bowron/Pitt/Raft, Chilko/Quesnel, Late Stuart/Stellako, Birkenhead, Adams/Lower Shuswap/Portage, and Weaver/Harrison/Cultus (Table 8). Both scale-based and DNA-based analyses included model adjustments on the basis of assumptions about the migratory timing of sockeye stocks. Application of models to scale data used *a priori* adjustment, i.e., inclusion of stock groups in models was based on their likelihood of presence (e.g., samples collected from Area 20 in July were not examined with models that included Birkenhead sockeye scale standards, due to their later migratory timing). Adjustments of DNA-based allocations were made *a posteriori* by examination of unadjusted results and consideration of predicted misallocation rates among stock groups (e.g., due to their earlier migratory timing, allocations to Early Stuart sockeye populations in samples collected from marine areas in August were interpreted as misclassification of Late Stuart sockeye).

Table 8. Individual stocks comprising the stock groups used in 2002.

Stock Group	Component Stocks
	Early Stuart
Early Stuart	Early Stuart stocks
	Early Summer
Fen/Bow/Pitt/Raft	Fennell, Bowron, Pitt, Raft, Chilliwack, Nahatlatch, Taseko
Nadina/Gates	Nadina, Gates
Scotch/Seymour	Scotch, Seymour, early Eagle, Cayenne, Upper Adams
	Summer
Chilko	Chilko, south end Chilko Lake
Quesnel	Horsefly, McKinley, Mitchell, Roaring, Wasko, Blue Lead
Late Stuart/Stellako	Stellako, Tachie, Middle River, Pinchi, Kuzkwa
	Late
Birkenhead	Birkenhead, Big Silver
Adams/L. Shuswap/Portage	Lower Adams, Portage, Lower Shuswap, Middle Shuswap, Little Shuswap, Shuswap Lake, late Eagle
Weaver/Harrison/Cultus	Weaver, Harrison, Cultus, Widgeon, Douglas

Stock-specific baseline standards for in-season scale analyses were developed from two sources. The preferred source was scales from previous year age 3 and age 4 siblings of current year age 4 and age 5 sockeye, respectively, because they reared together in the same nursery lake environment and thus had similar freshwater scale patterns. A second, less preferred source was used when sibling data from the previous year were unavailable. In this second method, baseline standards are developed using data from the same age class but from prior years. Because of the low return of age 3 fish in 2001 to all Fraser River sockeye spawning grounds (with the exception of Gates Creek and tributaries to Shuswap Lake used by Late-run sockeye) the majority of scales used in construction of standards for in-season models came from other years' age 4 returns. Relative to the use of jack samples, reliance on past years' age 4 scales to generate standards for returning 4-year olds increased uncertainty associated with results of in-season analyses. Age 5 sockeye were examined in-season using standards developed from siblings collected from spawning ground samples of age 4 sockeye in 2001. The utility of these latter models was limited by the greater-than-usual proportional dominance of 4-year old sockeye in 2002.

Stock identification is normally most challenging during short transition periods in catch proportions from mostly Early Summer-run stocks to high proportions of Summer-run stocks, and during the transition period from mostly Summer-run stocks to mostly Late-run stocks. The

problem was exacerbated in 2002, as it has been in other recent years, by the early return of Late-run sockeye and increased overlap in migration timing with Summer-run sockeye. Overlap in timing was so pronounced among runs that considerable overlap occurred between Early Shuswap stocks (that comprise part of the Early Summer-run) and Late Shuswap stocks (that comprise a large component of the Late-run). Stocks from the Early Summer-run, Summer-run, and Late-run timing-groups were all present in Whonnock test fishery catches during the first three weeks of August.

Fisheries removals of Fraser River sockeye in District 104 purse seine fisheries were estimated using discriminant function analysis for age 4_2 sockeye based on length data and data from four scale variables. The lengths of sockeye sampled from District 104 catches were measured as the distance from the middle of the eye to the fork of the tail. To enable comparative analyses, the lengths of Nass, Skeena, and Fraser River sockeye were converted. Nose-to-fork lengths were provided by DFO for Skeena River sockeye. No conversion equation was available for these Skeena sockeye fork-lengths; therefore, the relevant equations for Nass River sockeye were applied to complete the required conversions. These conversions are sex-specific and, because matched sex-data were not provided for the Skeena standard, analyses were performed for standards based on equations for both Nass River males and for Nass River females. The age composition of the Fraser River sockeye catch in Areas 12 and 20 was applied to expand the estimation of 4_2 Fraser River sockeye catch in District 104 to a catch estimate for all ages of Fraser River sockeye caught in that fishery.

B. Microsatellite DNA Program

In 2001, PSC staff collaborated with DFO to assess the use of microsatellite DNA markers to distinguish among Fraser River sockeye stocks. The results were encouraging. DNA-based estimates of stock abundances migrating past Mission were very similar to post-season, scale-based estimates. These results suggested that the DNA method could help overcome difficulties experienced with the scale-based method in recent years. The number of spawning ground samples in the DNA baseline was increased and a major histocompatability (MHC) locus with large differences in allelic frequency among populations was added in 2002. Temporal and spatial sub-sampling on selected spawning grounds suggested that within-stock variance was relatively small and, therefore, baseline samples collected to date were representative of the stocks. Simulation analyses conducted prior to the 2002 fishing season suggested that sample sizes of 96 individuals provided accurate and precise estimates of stock proportions in most mixture samples. The simulation studies also suggested that DNA analyses could provide a powerful tool for the identification of individual fish to stock of origin (an important component of the 2002 Late-run tagging study).

Rapid processing of sockeye DNA samples yielded timely results that helped guide in-season fisheries management decisions. Some of the DNA estimates early in the in-season period in 2002 raised concern about the accuracy of the DNA method. This concern was prompted by three factors: (1) early DNA analyses demonstrated some difficulty in distinguishing early Lower Mainland stocks from Late-run stocks from the same region and/or inability to distinguish Late-run Fraser sockeye from components of early non-Fraser sockeye stocks; (2) Early Shuswap stocks were returning in considerable numbers and assignment to Late Shuswap runs could be occurring due to misallocation rates that were greater than expected; and (3) the very early return of Late-run sockeye to the Strait of Georgia indicated by the genetic data would be extreme, even considering recent trends.

Several tests were applied in-season to evaluate the reliability of the DNA analyses. The results of the tests were favourable: (1) the timing of the other stock groups was reasonable; (2) marine purse seine samples yielded higher Late-run proportions than coinciding marine gill net samples; (3) DNA estimates of Early Shuswap proportions were not correlated with estimated Late Shuswap proportions; (4) the genotypes of supposed Late-run individuals were typical of simulated Late-run genotypes (had high likelihoods in Late-run sockeye) but had low likelihoods in other runs; (5) samples of individual sockeye that were positive for the brain parasite *Myxobolus arcticus* showed very similar scale patterns to individuals identified as Quesnel

sockeye with DNA, and *M. arcticus* prevalence in samples agreed with DNA-based estimates for sample mixtures; (6) age 3_1 and 4_1 fish were usually identified as Harrison River sockeye; and (7) scale patterns of individuals identified by DNA to stock of origin were similar with (though not identical to) pre-season standards for those stocks.

C. Estimates of Escapement and Production by Stock

Post-season estimates of racial proportions based on scales can differ from estimates made in-season. Such differences can be partially attributed to differences between pre-season scale pattern standards and standards developed from scales collected on the spawning grounds. The accuracy of pre-season scale standards has been limited, especially in recent years, because of the lack of available data from jacks. Allelic frequencies used in genetic analyses generally vary little among years, which typically results in smaller differences between in-season and post-season estimates of the gross escapement. The largest change in estimates of gross escapement for a run-timing group in 2002 was 2% (Table 9). However, larger shifts occurred within runs; the largest percentage changes occurred in Early Summer-run sockeye components. Sampling of DNA was particularly limited early in the in-season period and assignment of escapement among the Early Summer-run stock groups relied on proportions observed on the spawning grounds. Further, adjustment of timing assumptions for including and excluding stocks in the baseline (to limit the effect of small-stock estimation bias) also affected estimation of Early Summer-run sockeye abundance.

The total return of Early Stuart sockeye (62,000; Table 10) was 59% of the pre-season forecast. Recorded catches for this run included 1,000 fish in test and marine fisheries and 4,000 fish in Fraser River First Nations' fisheries. The exploitation rate for all catch areas was 8%. In addition, an estimated 32,000 Early Stuart sockeye died en route because of difficult migration conditions.

Table 9. Comparison of hydroacoustic-based gross escapement estimates for Fraser River sockeye salmon stocks in 2002, using in-season versus post-season stock composition estimates.

Run	Gross Escapement *		Difference	
	In-season	Post-season	Fish	%
Early Stuart	61,000	61,000	0	0%
Early Summer				
Bowr./Fenn./Raft/Pitt	129,000	195,000 **	66,000	51%
Nadina/Gates	16,000	7,000	(9,000)	(56%)
Seymour/Scotch	502,000	431,000	(71,000)	(14%)
Total	647,000	633,000	(14,000)	(2%)
Summer				
Chilko/Quesnel	4,202,000	4,190,000	(12,000)	(0%)
L.Stuart/Stellako	715,000	625,000	(90,000)	(13%)
Total	4,917,000	4,815,000	(102,000)	(2%)
Late				
Birkenhead	205,000	222,000	17,000	8%
Late Shuswap/Portage	5,795,000	6,041,000	246,000	4%
Weav./Harr./Cult.	627,000	516,000	(111,000)	(18%)
Total	6,627,000	6,779,000	152,000	2%
Total	12,252,000	12,288,000	36,000	0%

* Escapement past Mission plus First Nations catches below Mission.

** Includes actual upper Pitt River spawning escapement estimate.

Table 10. Catches, escapements, differences between estimates, run sizes and exploitation rates for Fraser River sockeye salmon (by stock group) in 2002.

Stock Group	River & Ocean Catch *	Gross Escapement: In-river FN, Recreational, & ESSR Catch **	Gross Escapement: Enumerated & Projected Spawning Escapement		Difference*** Between Estimates	Run Size: Adult	Run Size: Jacks	Portion of Run	Adult Exploitation Rate: River & Ocean	Adult Exploitation Rate: All Areas
Early Stuart	1,000	4,000	25,000		32,000	62,000	0	0%	2%	8%
Early Summer-run										
Bowr./Fenn./Raft/Pitt	44,000	19,000	143,000		0	206,000	0	1%	21%	31%
Nadina/Gates	5,000	1,000	4,000		0	10,000	3,000	0%	50%	60%
Seymour/Scotch	199,000	76,000	310,000		0	585,000	0	4%	34%	47%
Total	248,000	96,000	457,000		0	801,000	3,000	5%	31%	43%
Summer-run										
Chilko	172,000	91,000	383,000		0	646,000	2,000	4%	27%	41%
Quesnel	1,282,000	457,000	3,062,000	2	0	4,801,000	0	32%	27%	36%
L.Stuart/Stellako	259,000	132,000	359,000		155,000	905,000	0	6%	29%	43%
Total	1,713,000	680,000	3,804,000		155,000	6,352,000	2,000	42%	27%	38%
Late-run										
Birkenhead	41,000	1,000	219,000	2	0	261,000	0	2%	16%	16%
Late Shuswap/Portage	1,019,000	228,000	5,547,000		266,000	7,060,000	0	47%	14%	18%
Weav./Harr./Cult. ****	80,000	112,000	1 149,000		255,000	596,000	0	4%	13%	32%
Total	1,140,000	341,000	5,915,000		521,000	7,917,000	0	52%	14%	19%
Total Adults	3,102,000	1,121,000	10,201,000		708,000	15,132,000	5,000	100%	20%	28%
Total Jacks	0	0	5,000		0	5,000				
Total	3,102,000	1,121,000	10,206,000		708,000	15,137,000				
Portion of Total Run	20%	7%	67%		5%	100%				

* Includes catches in all fisheries, excluding Fraser River First Nations, recreational, ESSR and SCS fisheries.

** FN = First Nations; ESSR = Excess Salmon to Spawning Requirements.

*** Differences between gross escapement estimates are the lower river estimates (Mission + IF catch, PSC) minus up-river estimates (spawning escapement + FN catch + recreational catch + ESSR catch, DFO).

**** In addition to ESSR catches, a large but unquantified escapement en route to Weaver Creek was blocked at Morris Slough and assumed to die without spawning.

1 In-river catches of Weaver sockeye include ESSR catches of 9,000 in Morris Slough and 100,000 in Weaver Channel.

2 Spawning escapements were only partially enumerated for Quesnel and Birkenhead stock groups, so spawning escapements here are projected from Mission escapements in 2002.

The estimated return of Early Summer-run stocks was 801,000 sockeye, approximately 18% greater than the pre-season forecast of 678,000. The Scotch/Seymour stock-group dominated the run and greatly exceeded pre-season expectations of their abundance. Catch estimates for Early Summer-run sockeye included 248,000 fish in commercial, test, and miscellaneous fisheries, and 96,000 fish in Fraser River recreation and First Nations' fisheries. The estimated exploitation rate on Early Summer-run stocks was 43%, with a higher exploitation rate estimated for the Scotch/Seymour component than for the earlier-timed stocks (Table 10).

Quesnel stocks dominated the total return of Summer-run sockeye according to DNA-based estimates of stock proportions; however, DFO only conducted spawning ground assessments of the Mitchell River stock (including Cameron and Penfold creeks). The ratio between Mitchell and other Quesnel stocks estimated at Mission was applied to derive a spawning ground estimate for Quesnel in total. Of the estimated 6,352,000 sockeye returning Summer-run sockeye (71% of the pre-season forecast), an estimated 4,801,000 fish were produced from spawning areas in the Quesnel system. The run sizes of the Chilko and Late Stuart/Stellako stock-groups were 646,000 fish and 905,000 fish, respectively (Table 10).

Catches from commercial, test, and miscellaneous fisheries totalled 1,713,000 sockeye, while Fraser River sport and First Nations' fisheries caught an estimated 680,000 sockeye. The overall exploitation rate for all fishing areas was estimated at 38%, with Late Stuart/Stellako experiencing the highest exploitation rate of the stock-groups (43%). Lower-river estimates of Summer-run upstream migration exceeded up-river estimates (catch + spawning escapement) by a total of 155,000 sockeye. Analysis of Fraser River environmental conditions resulted in a prediction of no

significant en route mortality for Summer-run sockeye, but the proportional difference between Mission and upstream accounting was large for the Late Stuart/Stellako stock group. Late Stuart spawning escapement was estimated visually rather than with mark-recapture techniques, which likely resulted in some underestimation of that stock.

The estimated return of 7,917,000 adult Late-run sockeye (including Birkenhead) was 121% higher than the pre-season forecast of 3,577,000 fish. This large return was due to Adams/Lower Shuswap stocks (the Weaver/Cultus/Harrison return approximated the forecast whereas the Birkenhead return was 38% less than the pre-season forecast). Commercial, test, and miscellaneous catches of Late-run stocks totalled 1,140,000 sockeye and an additional 341,000 sockeye were caught in Fraser River recreational and First Nations' fisheries. The estimated exploitation rate for true Late-run sockeye including 9,000 fish in ESSR fisheries and a removal of Weaver spawning channel surplus of 100,000 sockeye was 19% (and 17% if Weaver Creek ESSR catches and spawning channel surplus removals are excluded from this estimate). The stock-specific exploitation rate was greatest for Weaver because of the additional removals (Table 10). The difference between lower-river and up-river estimates of gross escapement (521,000 fish for Late-run sockeye as a whole) was most pronounced for the Late Shuswap/Portage stock-group. The Birkenhead component of the Birkenhead/Big Silver stock-group was not enumerated on the spawning grounds; therefore, lower-river estimates were adopted for Birkenhead. As a result, only the difference between lower-river and up-river estimates of Adams/Lower Shuswap/Portage was evaluated. The estimated en route loss of 266,000 Adams/Lower Shuswap/Portage sockeye (4% of the escapement) was lower than recent years when this group exhibited early upstream migration.

VIII. ESCAPEMENT

The enumeration of sockeye salmon spawning escapements in the Fraser River watershed (Figure 6) is conducted annually by DFO. Data collected in this program were used to generate estimates of total sockeye production on a stock and run-timing group basis. The Fraser River Panel also relies on the escapement estimates to determine if the spawning escapement goals have been met. This is the highest priority objective of the Panel's in-season management. Further, the escapement estimates and data collected on the spawning grounds by DFO help in the post-season evaluation of stock identification and stock monitoring programs conducted by PSC staff. These samples and data include scales, otoliths, and tissues and length measurement data collected by DFO for processing by PSC staff.

In 2002, DFO's spawning ground enumeration of sockeye was incomplete because only the Mitchell River, Penfold Creek and Cameron Creek were enumerated in the Quesnel system and Birkenhead River sockeye were also not enumerated. Consequently, it was not possible to make accurate and consistent comparisons of 2002 escapements for total Fraser, Quesnel, total Summer-run, Birkenhead, and total Late-run sockeye escapements to prior return years. The escapement of 5,400 enumerated jack sockeye (age 3 fish) was 4% lower than in the brood year. The Early Stuart escapement of 25,000 sockeye (Table 11) was 19% lower than the brood year (1998) escapement of 31,000 fish. Escapements of Early Summer-run stocks increased to 457,000 fish, which was the largest escapement for this cycle since comprehensive surveys began in 1938. Approximately 5,696,000 Late-run sockeye (excluding Birkenhead sockeye) arrived at their spawning grounds in 2002, which was over three times larger than the brood year escapement and the largest escapement for this timing-group since comprehensive surveys began in 1938.

The distribution of the 25,000 Early Stuart sockeye spawners in 2002 was 15,000 fish to tributaries of Takla Lake, 6,000 fish to the Middle River, and 3,500 fish to tributaries of Trembleur Lake (A; Figure 6). High Fraser River discharge levels during the Early Stuart sockeye migration probably contributed to the unusually long migration period between Mission and the Fort Saint James Bridge (28 days versus an average of approximately 18 days). High river levels likely caused some en route mortality of Early Stuart sockeye in 2002.

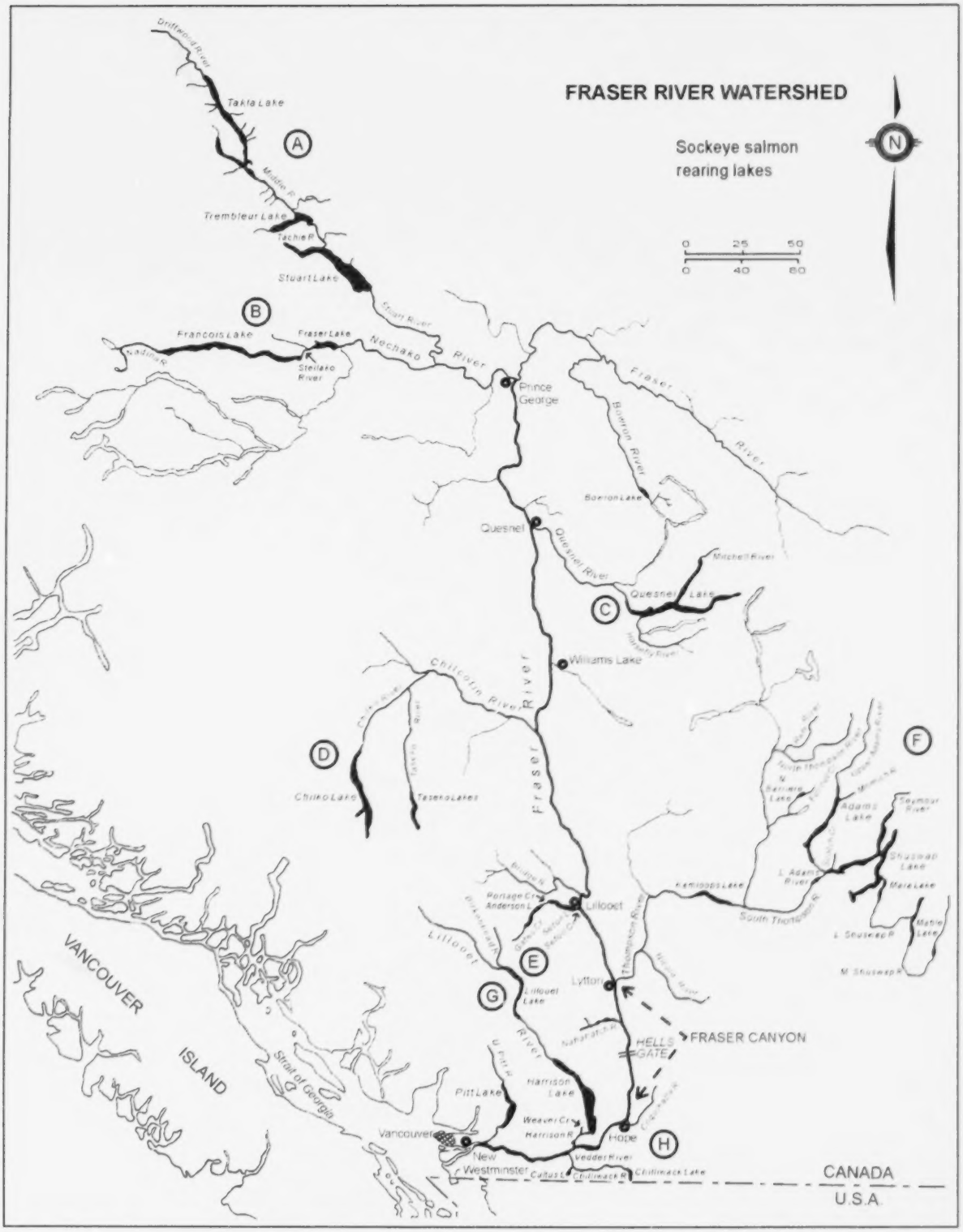

Figure 6. Sockeye salmon spawning grounds in the Fraser River watershed.

Table 11. Adult sockeye salmon escapements by run-timing group on the 2002 cycle for years 1986-2002.

	Spawning Escapement				
Run	1986	1990	1994	1998	2002
Early Stuart	29,000	97,000	30,000	31,000	25,000
Early Summer	225,000	441,000	248,000	226,000	457,000
Summer	581,000	1,597,000	1,352,000	2,381,000	3,804,000
Late	2,823,000	3,929,000	1,499,000	1,781,000	5,915,000
Adults	3,658,000	6,064,000	3,129,000	4,419,000	10,201,000

The escapement of 35,000 Late Stuart sockeye was only 25% of the brood year escapement (136,000 fish). Escapements to the Tachie River (20,000) and Middle River (7,000) were only 21% and 20% of their brood year levels, respectively. Although the number of Late Stuart sockeye that returned to spawn in 2002 was much lower than the brood year, spawning success was estimated at almost 100%.

Early Summer-run sockeye escapements to the Nechako system (B; Figure 6) included 1,900 fish to the Nadina River (and spawning channel), and Glacier Creek, which was 52% of the brood year escapement. Although this escapement was low, the spawning success was estimated at 99%. The escapement of Summer-run sockeye to the Stellako River was 323,000 fish, which was 74% higher than the brood year escapement. The estimated spawning success of Stellako sockeye in 2002 was also excellent (100%).

Spawning escapements to the Bowron River increased from 4,800 fish in 1998 to 8,800 fish in 2002. The 4,700 female spawners had an estimated spawning success rate of 96%.

As noted above, spawning ground enumerations in the Quesnel system were incomplete in 2002. Of the 86 Quesnel sockeye spawning populations generally enumerated by DFO, only the Mitchell River, Cameron and Penfold Creeks were enumerated in 2002. These escapements totalled 1,022,000 fish, which was approximately three times higher than the brood year. The "Racial Identification" section of this report includes a projection of the total Quesnel-area sockeye escapements in 2002.

Chilko River and Lake escapements (D; Figure 9) of 383,000 Summer-run sockeye were only 44% of the brood year escapement. However, spawning success was estimated at almost 100%. The escapement of approximately 1,300 Early Summer-run sockeye to Taseko Lake was almost ten times higher than the recent cycle-year average and spawning success was estimated at 100%.

Early Summer-run escapements to Gates Creek and Channel in the Seton-Anderson system (E; Figure 6) decreased from about 8,700 fish in the brood year to 4,700 fish in 2002. Of the 4,700 sockeye that returned to Gates Creek and channel, an estimated 2,500 of them were age 3 jacks. The success of sockeye spawning in Gates Creek and channel averaged 85%, which exceeded the historic average of 75%. The return of Late-run sockeye to Portage Creek decreased from 25,000 fish in the brood year to 15,000 fish in 2002. Some Portage Creek sockeye may have experienced en route mortality; however, detection of dead Portage Creek sockeye in Seton Lake is difficult. The spawning success of Portage Creek females that reached the spawning grounds was 99%.

Sockeye stocks in the Thompson River watershed spawn in the North Thompson and South Thompson River systems (F; Figure 6). In the South Thompson, the Early Summer-run escapement of 113,000 Seymour River sockeye was over three times the brood year escapement and spawning success was 99%. Escapements to Scotch Creek (101,000 fish) and Eagle River (65,000 fish) were the highest on record for this cycle line and spawning success was excellent for both stocks (98% and 99%, respectively). The Anstey River escapement of 20,000 sockeye was the second highest on record and the spawning success was almost 100%.

Late-run sockeye escapements to the South Thompson River watershed totalled 5,532,000 fish, which was four times higher than the brood year escapement and the largest escapement since comprehensive surveys began in 1938. The spawning success of these sockeye averaged 97%. Very large escapements were enumerated for: Adams River (3,738,000 fish), Lower Shuswap River (781,000 fish), and Little River (679,000 fish). In spite of early in-river migration, the period of peak spawning was normal for these stocks. En route mortality appeared to be low since few carcasses were observed in holding areas. The abundance of lake-shore spawners in Shuswap Lake exceeded brood year levels by over ten times, and several new lake-shore spawning areas were identified.

In the North Thompson area, an estimated 26,000 Early Summer-run sockeye returned, which was approximately double the brood year escapement. Raft River had an escapement of 18,000 fish, which was over two times larger than the brood year escapement and the spawning success was 97%. Fennell Creek spawners (7,200 fish) achieved a spawning success rate of 98%.

Similar to the Quesnel system, spawning enumeration programs in the Harrison-Lillooet area (G; Figure 6) were reduced in 2002. The Birkenhead River is one of the main sockeye stocks in this area, and it was not enumerated in 2002. (Refer to the "Racial Identification" section of this report for a projection on the escapement of Birkenhead sockeye in 2002.) The spawning success of Birkenhead sockeye was estimated at 99%. Big Silver Creek (a tributary of Harrison Lake) had an escapement of 30,000 sockeye, which was the largest on record and approximately five times higher than the brood year level. The escapement of Harrison River sockeye was 42,000 fish, which was also a record escapement for this stock and was approximately nine times higher than in the brood year. Approximately, 101,000 sockeye returned to Weaver Creek and spawning channel, which was almost double the brood year escapement. The spawning success of the 66,000 Weaver Creek spawners was 66%, while it was 89% for the 35,000 spawners in the channel.

The total escapement of 101,000 Early Summer-run sockeye to Lower Fraser River tributaries (H; Figure 6), slightly exceeded the brood year escapement. The escapement of 7,000 Nahatlatch sockeye was marginally below the brood year, although spawning success was high in both the Nahatlatch River (100%) and Nahatlatch Lake (98%). The escapement of Upper Pitt River sockeye (90,000 fish) was the largest on record for this cycle and the third highest for all cycle years. Spawning success of these fish was estimated at 97%. The escapement of 4,900 Late-run sockeye to Cultus Lake was approximately two times the brood year escapement and the recent cycle-year average. The spawning success of these fish was estimated at 87%. The first observations of Cultus sockeye at the Sweltzer Creek fence occurred on August 2, which was the earliest on record.

The overall spawning success of adult female sockeye salmon in the Fraser River watershed in 2002 was 96.4%, which was slightly higher than observed in 1998 (93.7%).

IX. ACHIEVEMENT OF OBJECTIVES

The mandate of the Fraser River Panel is to manage commercial fisheries in the Panel Area to achieve a hierarchy of annual goals. In order of importance, the goals are to: (a) achieve spawning escapement targets for Fraser River sockeye and pink salmon that are set by Canada or modified by Panel agreement; (b) achieve targets for international sharing of the TAC as defined in the Treaty or by agreement of the Parties; and (c) achieve domestic catch allocation goals within each country. In the process of achieving these objectives, the Panel must consider conservation concerns for other stocks and species of salmon when planning and conducting the fisheries. Panel management strategies are assessed after each season to determine whether the goals were achieved and to identify management techniques and data collection programs that could be improved.

On February 17, 2005, the Panel agreed on a revised Chapter 4, Annex IV of the Pacific Salmon Treaty. The revised Annex established new methods for making management decisions, and for calculating the TAC and paybacks from 2005 onward. However, associated with the agreement was a decision by the Panel to apply the new method for calculating the TAC in 2002, 2003 and 2004. Whereas the traditional method used post-season estimates of run size, spawning escapement and test-fishing catch in the calculation, the new method uses the estimates of run size, spawning escapement target, management adjustment and test fishing catch that were in effect when the Panel relinquished control of the last U.S. Panel Area (September 28 in 2002). The new method is therefore based on in-season data rather than post-season data to calculate the total sockeye available for sharing. In the context of assessing the achievement of objectives, this premise is applied not only to the achievement of the TAC and catch allocation targets, but also to the achievement of gross escapement targets.

A. Gross Escapement

The Panel's first task is to achieve gross escapement targets by run-timing group (Early Stuart, Early Summer-run, Summer-run and Late-run sockeye) that are set by Canada. Gross escapement targets incorporate fish for spawning (highest priority, noted above) and for First Nations and recreational harvest in the Fraser River. In-season gross escapement targets may also include additional fish in the category, "Management Adjustments", which are designed to increase the likelihood of successfully achieving the spawning escapement targets.

In 2002, the Panel initially adopted a pre-season Management Adjustment on May 22 of 87,000 Early Summer-run fish, to compensate for the historical tendency for in-season escapement estimates to exceed upriver estimates. The adjustment was subsequently modified to 43,000 fish on July 26, based on estimates from the Early Summer-run EMA model and indications that migration conditions in the river would be more favourable than originally projected.

There are two ways of assessing the achievement of gross escapement targets:

1. Did in-season estimates of gross escapement meet the adjusted gross escapement targets?
2. Did up-river gross escapement estimates meet the unadjusted targets?

By the first measure (Table 12), the adjusted gross escapement target was achieved for Early Stuart sockeye, but exceeded for the Early Summer-run (252,000 fish over), Summer-run (1,987,000 fish over) and Late-run sockeye (224,000 fish over). The summed gross escapements exceeded the target by 2,463,000 fish.

By the second measure (Table 13), up-river estimates of gross escapement were below the targets for Early Stuart (32,000 fish under) and Late-run sockeye (147,000 under), and higher than the targets for Early Summer-run (201,000 fish over) and Summer-run sockeye (1,554,000 fish over). In total, the up-river estimate of gross escapement was 1,576,000 fish more than the in-season target. The estimates for Summer-run and Late-run stocks are uncertain, because spawning enumeration programs were not conducted for Quesnel (except for Mitchell River, Cameron Creek and Penfold Creek) and Birkenhead stocks.

Table 12. Comparison of in-season adjusted targets at the time the Panel relinquished control of the last U.S. Panel Area (September 28) and in-season gross escapement estimates, for adult Fraser River sockeye salmon in 2002.

	Gross Escapement					
	In-season	Management	Adjusted	In-season	Difference	
Run	Target	Adjustment*	Target	Estimate**	Fish	%
Early Stuart	61,000	0	61,000	61,000	0	0%
Early Summer	352,000	43,000	395,000	647,000	252,000	64%
Summer	2,930,000	0	2,930,000	4,917,000	1,987,000	68%
Late	6,403,000 *1*	0	6,403,000	6,627,000	224,000	3%
Adults	9,746,000	43,000	9,789,000	12,252,000	2,463,000	25%

* Panel-agreed adjustment of gross escapement targets to achieve spawning escapement goals.

** Includes 247000 sockeye caught in Fraser River First Nations' fisheries below Mission, B.C.

1 The escapement target for True Lates was 85% of the total run size (i.e., 100% minus the exploitation rate target of 15%) minus the early catch (292,000, Mission date of Aug. 17).

Table 13. Comparison of in-season unadjusted targets at the time the Panel relinquished control of the last U.S. Panel Area (September 28) and upriver gross escapement estimates, for adult Fraser River sockeye salmon in 2002.

	Gross Escapement			
	In-season	Upriver	Difference	
Run	Target	Estimate*	Fish	%
Early Stuart	61,000	29,000	(32,000)	(52%)
Early Summer	352,000	553,000	201,000	57%
Summer	2,930,000	4,484,000	1,554,000	53%
Late	6,403,000 *1*	6,256,000	(147,000)	(2%)
Adults	9,746,000	11,322,000	1,576,000	16%

* Reported spawning escapements plus Fraser River First Nations and recreational fishery catches, and excluding differences between estimates.

1 The escapement target for True Lates was 85% of the total run size (i.e., 100% minus the exploitation rate target of 15%) minus the early catch (292,000, Mission date of Aug. 17).

Because of fishery restrictions to protect Early Stuart sockeye, only about 5,000 Early Stuart fish were caught, 1,000 in Panel-approved test fisheries and 4,000 in Fraser River First Nations fisheries. Thus, the shortfall in Early Stuart gross escapement was not due to Panel action but to en route mortality or error in estimates of Mission escapement, spawning escapement or catch above Mission. River discharges exceeded 9,000 cms during the Early Stuart migration. Since 8,000 cms is considered a critical level above which sockeye migration is hindered and mortalities may occur, en route mortality was likely the primary cause of the shortfall. The gross escapement overages for Early Summer-run and Summer-run sockeye, however, were largely due to Panel action designed to maximize the escapement of Early Stuart, Early Summer-run and Late-run fish. In particular, the 15% harvest rate limit for Late-run fish combined with an unusually large overlap in the Summer-run and Late-run sockeye migrations led to more severe fishery restrictions than expected pre-season and to excess escapement of Summer-run fish. In the pre-season plan, Summer-run sockeye were to be the main target of fisheries in 2002.

B. International Allocation

The Panel's second priority is to achieve the goals for international allocation of the Total Allowable Catch (TAC). For 2002, a new method of calculating the TAC was implemented as a result of the February 17, 2005 agreement.

Table 14. Preliminary calculations of total allowable catch and international shares for Fraser River sockeye salmon in 2002. In-season estimates of run size, spawning escapement target, management adjustment and test fishing catch at the time the Panel relinquished control of the last U.S. Panel Area (September 28) were used, according to the revised Annex IV agreed to on February 17, 2005.

		Sockeye
TOTAL ALLOWABLE CATCH		
Total Run Size		15,312,000
Deductions		
In-season Spawning Escapement Target	*1*	8,970,000
In-season Management Adjustment	*1*	43,000
Fraser River Aboriginal Fishery Exemption		400,000
In-season Test Fishing Catch		155,000
Total Deductions:		9,568,000
Total Allowable Catch:		5,744,000
UNITED STATES		
Washington Catch		449,000
Washington Share		
Washington Share	*2*	948,000
Payback	*3*	(47,000)
Total Share:		901,000
Deviation:	*4*	(452,000)
Alaska Catch		1,000
Total United States Catch:		450,000
CANADA		
Canadian Catch - Aboriginal Fishery Exemption - ESSR	*5*	3,108,000
Canadian Share		4,842,000
Deviation:	*4*	(1,734,000)

1 By Panel agreement (Feb. 17, 2005), the TAC calculation used the spawning escapement target and management adjustment based on accounted run sizes at the time the Panel relinquished control of the last U.S. Panel Area (Sept. 28).
- In accordance with previous agreements (June 12, 2002 and Feb. 12-13, 2003), the spawning escapement target for True Lates (6,091,000) = 85% of the run (6,383,000) minus the early catch (292,000, Cottonwood date of Aug. 17). The Birkenhead target was fixed at the 75% p-level target of 174,000 spawners. Targets for the other run-timing groups are based on the accounted estimates of run size and DFO's pre-season spawning escapement target plan.

2 United States share according to revised Annex IV of the Pacific Salmon Treaty: Sockeye: 16.5% of the TAC - payback (maximum 5% of share).

3 Paybacks used for in-season TAC calculations, based on calculation method in effect at the time, i.e., the lesser of 56,000 payback or 5% of U.S. share (0.05*948,000=47,000).

4 By agreement of the Parties (Feb. 17, 2005), no additional paybacks of overages or underages are due as a result of these calculations, for 2002, 2003 and 2004.

5 ESSR catch of 9,000 Weaver sockeye and Weaver Channel Surplus Harvest of 100,000 sockeye subtracted from Canadian catch.

The key element of the new method for calculating the TAC is that the final in-season spawning escapement target replaces the actual spawning escapement estimate as the escapement deduction. This agreement led to TAC and share calculations (Table 14) that differed from past practices in the following ways:

1. The run size is the in-season accounted run-size estimate on the date that the Panel relinquished control of the last U.S. Panel Area (in 2002, this occurred on September 28).
2. The spawning escapement deduction is the in-season spawning escapement target (Table 15), instead of the actual spawning escapement estimate as in past years. In this calculation, the escapement targets for Early Stuart, Early Summer-run and Summer-run sockeye are based on final in-season run-size estimates and DFO's pre-season spawning escapement plan, the target for Birkenhead is set to the 75% p-level target of 174,000 fish by an in-season agreement, and the target for Late-run sockeye (excluding Birkenhead) is

85% of the final in-season run-size estimate minus the early catch (referenced to a Cottonwood[5] date of Aug. 17) of 292,000 Late-run sockeye (excluding Birkenhead).

3. The in-season management adjustment of 43,000 Early Summer-run fish is included as a deduction. In past years, the management adjustment was dropped from the post-season TAC calculation when the actual spawning escapement became the escapement deduction.

With the total run size of 15,312,000 Fraser sockeye minus the deductions for spawning escapement, management adjustment, Fraser River Aboriginal Exemption and test fishing catch, the TAC in 2002 was 5,744,000 sockeye (Table 14). Washington's share was 16.5% of the TAC minus the maximum payback of 47,000 fish (the lesser of 56,000 or 5% of Washington's share), for a total share of 901,000 fish. Subtracting this share from their catch of 449,000 leaves a catch shortfall of 452,000 sockeye. Canadian fishers caught 3,108,000 sockeye (excluding the Fraser River Aboriginal Exemption of 400,000 sockeye, ESSR catch of 9,000 fish and Weaver Channel Surplus Harvest of 100,000 fish), leaving a catch shortfall of 1,734,000 sockeye.

Table 15. Spawning escapement targets based on in-season run-size estimates at the time the Panel relinquished control of the last U.S. Panel Area (September 28), according to the revised Annex IV agreed to on February 17, 2005.

Run	In-season Run Size	Spawning Escapement Target		Catch To Aug. 17 Mission Date
Early Stuart	62,000	58,000	*	
Early Summer	899,000	270,000		
Summer	6,604,000	2,377,000		
Late	7,747,000	6,265,000		
Birkenhead	238,000	174,000	**	
True Late-run	7,509,000	6,091,000	***	292,000
Total	15,312,000	8,970,000		

* Early Stuart target reduced by 4,000 to account for in-season estimate ofFraser River Aboriginal Exemption and PSC test fishery catch.

** Birkenhead target fixed at 75% p-level target of 174,000 spawners.

*** True Late-run target is 85% of the total run, minus 292,000 fish caught on and before Aug. 17 (Mission date).

C. Domestic Allocation

The third priority of the Panel is to achieve domestic allocation goals as specified by the Parties. The Panel's ability to achieve these goals is limited because the Panel manages only commercial fisheries in Panel Areas that are directed at Fraser River sockeye and pink salmon. Canada regulates Canadian commercial net fisheries in non-Panel areas such as Johnstone Strait, and First Nations and recreational fisheries in all fishery areas.

In 2002, the Panel was relatively successful in achieving allocation targets between Treaty Indian and Non-Indian fishers in Washington. Treaty Indian fishers caught only 3,000 fish less than their target of 316,000 fish, while Non-Indian fishers caught 3,000 fish over their target of 133,000 fish (Table 16). Within the Treaty Indian group, fishers in Areas 4B, 5 and 6C achieved their minimum share of 12.5% of the Treaty Indian share with a catch of 44,000 fish. Within the Non-Indian group, purse seines and reefnets caught 2,000 and 11,000 fish more than the targets, respectively, while gillnets caught 13,000 fish less.

[5] Cottonwood is the site of the "below-bridge" or "lower-river" gillnet test fishing site, located about 21 km below the Port Mann Bridge and 28 km below Mission. Sockeye salmon take about 1 day to migrate from Cottonwood to Mission.

The achievement of domestic allocation goals in Canada (Table 17) was less successful, mainly because of severe fishery restrictions to protect Late-run stocks. Within the Canadian commercial catch of 2,218,000 Fraser sockeye, only Area E gillnets exceeded their allocation (318,000 fish over). In the other license areas, Area B purse seines were 83,000 fish under, Area D gillnets were 79,000 fish under, Area G trollers were 22,000 fish under and Area H trollers were 134,000 fish under their allocations.

Table 16. Preliminary estimates of domestic overages and underages in Washington catches of Fraser River sockeye salmon in 2002.

User Category	Actual Catches		Catch Goals		Deviation	
	Fish	%	Fish	%	Fish	%
Treaty Indians: by Area						
Treaty Indian						
Areas 4B, 5 and 6C *	44,000	14.1%	44,000	14.1%	0	0%
Areas 6, 7 and 7A	269,000	85.9%	269,000	85.9%	0	0%
Total:	313,000	100.0%	313,000	100.0%	0	
Non-Indians: by Gear						
Purse Seine	75,000	55.1%	73,000	54.0%	2,000	3%
Gillnet	43,000	31.6%	56,000	41.0%	(13,000)	(23%)
Reefnet	18,000	13.2%	7,000	5.0%	11,000	157%
Total:	136,000	100.0%	136,000	100.0%	0	
Washington: between Treaty Indian and Non-Indian Users						
Treaty Indian **	313,000	69.7%	316,000	70.5%	(3,000)	(1%)
Non-Indian	136,000	30.3%	133,000	29.5%	3,000	2%
Washington Total:	449,000	100.0%	449,000	100.0%	0	

* TI 4B,5,6C allocation is minimum of 12.5% of the TI share.

** TI share = 67.7% of the U.S. catch - 58.9% (23/56) of the U.S. payback.

Table 17. Preliminary estimates of domestic overages and underages in Canadian catches of Fraser River sockeye salmon in 2002.

Gear License Area	Actual Catches		Catch Goals		Deviation	
	Fish	%	Fish	%	Fish	%
Purse Seine						
A Northern	0	0.0%	0	0.0%	0	
B Southern	738,000	33.3%	821,000	37.0%	(83,000)	(10%)
Total	738,000	33.3%	821,000	37.0%	(83,000)	
Gillnet						
D Johnstone Strait	243,000	11.0%	322,000	14.5%	(79,000)	(25%)
E Fraser River	950,000	42.8%	632,000	28.5%	318,000	50%
Total	1,193,000	53.8%	954,000	43.0%	239,000	
Troll						
F Northern	0	0.0%	0	0.0%	0	
G Southern	155,000	7.0%	177,000	8.0%	(22,000)	(12%)
H Inside	132,000	6.0%	266,000	12.0%	(134,000)	(50%)
Total	287,000	12.9%	443,000	20.0%	(156,000)	
Total	2,218,000	100.0%	2,218,000	100.0%		

D. Conservation of Other Stocks

Due to restricted fishing in Canadian areas in Juan de Fuca Strait (Area 20) and other areas, catches of non-target species and stocks in Panel Area fisheries directed at Fraser River sockeye were low (Table 18). The recorded by-catches totalled 1,200 non-Fraser sockeye, 400 non-Fraser pink, 7,500 chinook, 5,200 coho, and 100 chum salmon.

Table 18. Preliminary estimates of catches of non-Fraser sockeye and pink salmon and of other salmon species in commercial fisheries regulated by the Fraser River Panel in 2002.

	Non-Fraser		Fraser and Non-Fraser			
Area and Gear	Sockeye	Pink	Chinook	Coho	Chum	Steelhead
United States *						
Areas 4B, 5 and 6C Net	1,200	200	1,000	4,900	100	0
Areas 6, 7 and 7A Net	0	0	2,200	300	0	0
Total	1,200	200	3,200	5,200	100	0
Canada **						
Area 20 Net	0	200	0	0	0	0
Area 29 Net	0	0	4,300	0	0	0
Total	0	200	4,300	0	0	0
Total	1,200	400	7,500	5,200	100	0

* Estimates are from the WDFW "soft-system".
** Estimates are from DFO in-season hail program.

X. ALLOCATION STATUS

In accordance with the payback policy in the revised (1999) Annex IV of the Treaty, catch overages and underages were to be used to adjust United States shares in subsequent years. With the payback agreements that were in place in 2002, the United States repaid the maximum allowable amount (47,000 fish) of the 56,000 fish payback carried over from past years, leaving a United States catch overage of 9,000 Fraser sockeye and a catch underage of 21,000 Fraser pink salmon going into the 2003 fishing season (Table 19).

Table 19. Allocation status of Fraser River sockeye and pink salmon for 1999-2002.

	Sockeye				Pink	
	1999	2000	2001	2002	1999	2001
TOTAL ALLOWABLE CATCH						
Total Run Size	3,643,000	5,217,000	7,213,000	15,312,000	3,616,000	21,293,000
Escapement and other deductions	3,438,000	3,198,000	6,132,000	9,568,000	3,468,000	19,881,000
Total Allowable Catch:	205,000	2,019,000	1,081,000	5,744,000	148,000	1,412,000
UNITED STATES						
Washington Catch	20,000	494,000	241,000	449,000	17,000	445,000
Washington Share *	46,000	412,000	241,000	496,000	38,000	445,000
Deviation:	(26,000)	82,000	0	(47,000)	(21,000)	0
Cumulative Allocation Status:	(26,000)	56,000	56,000	9,000	(21,000)	(21,000)

* Washington share of the TAC according to Annex IV of the Pacific Salmon Treaty:
1999: Shall not exceed 22.4% for Fraser sockeye and 25.7% for Fraser pinks.
2000: Shall not exceed 20.4% for Fraser sockeye.
2001: Washington share equals Washington catch for Fraser sockeye and pink salmon, by agreement between the Parties on June 12, 2002.
2002: The Washington share equals the Washington catch plus the maximum payback, in accordance with the Feb. 12-13, 2003, Panel agreement.

XI. APPENDICES

APPENDIX A: 2002 PRE-SEASON FORECASTS AND SPAWNING ESCAPEMENT TARGETS FOR FRASER RIVER SOCKEYE SALMON

Table 1. Pre-season forecasts for Fraser River sockeye salmon (in thousands of fish). (Provided to the Panel by Fisheries and Oceans Canada).

	Probability of Achieving Specified Run Sizes [a]				
Stock/Timing	25%	50%	75%	80%	90%
Early Stuart	**184**	**105**	**59**	**52**	**36**
Early Summer	**1,059**	**678**	**326**	**198**	**124**
'Unforecasted'		185	89		
Fennell	52	27	14	12	8
Bowron	46	26	15	13	9
Raft	49	27	15	13	8
Gates	52	30	18	16	11
Nadina	53	30	17	15	10
Pitt	118	63	33	28	19
Seymour	192	102	54	46	30
Scotch	498	189	72	56	29
Mid Summer	**15,931**	**9,006**	**5,204**	**4,549**	**3,195**
Chilko	1,671	946	535	464	318
Quesnel	11,223	6,721	4,024	3,541	2,521
Stellako	968	615	391	349	258
Late Stuart	2,070	724	254	195	97
Late Summer	**5,134**	**3,578**	**2,322**	**1,981**	**1,505**
'Unforecasted'		265	128		
Birkenhead	779	421	227	195	130
Late Shuswap	3,139	2,300	1,679	1,545	1,226
Cultus	13	7	3	3	2
Portage	458	208	95	78	46
Weaver	745	376	190	160	102
Total	**22,309**	**13,366**	**7,911**	**6,780**	**4,859**

a Probability that the actual run size will exceed the specified projection.

Table 2. Fraser River sockeye salmon escapement plan (in thousands of fish) for 2002. (Provided to the Panel by Fisheries and Oceans Canada).

Run	Forecast Return	Run Size Reference Points *b*	Escapement Target at Forecast Return	Harvest Rate Guidelines	Harvest Rate at Forecast
Early Stuart		0 - 75		0%	
	105	75 - 107	75	0 - 30%	28.6%
		107 - 214		30 - 65%	
		214		65-70%	
Early Summer		0 - 267		0 - 15%	
		267 - 649		15 - 65%	
	678	649	227	65-70%	66.5%
Summer		0 - 2,714		0 - 30%	
		2,714 - 5,278		30 - 64%	
	9,006	5,278	3,242	64-64%	64.0%
Late		0 - 2,095		0 - 15%	
	3,578	2,095 - 5,089	1,781	15 - 65%	50.2%
		5,089		65-70%	
Totals	13,367 Return		5,325 Escapement		8,042 Catch

b Reference points based on harvest rate targets

APPENDIX B: COMMISSION GUIDANCE TO THE FRASER RIVER PANEL AND PSC STAFF, JUNE 12, 2002

Commission Guidance to the Fraser River Panel and PSC Staff

The purpose of this document is to provide Commission direction to the Fraser River Panel and the PSC staff for 2002 on implementing the Pacific Salmon Treaty and 1999 Revised Annexes, and on making improvements to the Fraser River Panel process. This direction is not intended to replace the Diplomatic Note of August 13, 1985 regarding implementation of Article XV (paragraph 3) of the Pacific Salmon Treaty regarding the roles and responsibilities of the Pacific Salmon Commission staff.

An Improved Fraser River Panel Process

1) In-Season Run Size Projections and Fishery Management Recommendations

a) PSC staff will provide the Fraser River Panel with recommendations for in-season run size and other factors relevant to sound fisheries management decisions. Based on information such as, but not limited to, in-season estimates of run timing and diversion rate, the PSC staff will make recommendations to the Fraser River Panel regarding in-season decision making.

b) PSC staff will provide the Fraser River Panel with projected harvestable surpluses and status of harvest from fisheries under Panel management. These projections will incorporate any Fraser River Panel agreement on management adjustments that deal with environmental conditions during in-river migration that could significantly impact the Fraser River Panel's ability to achieve spawning escapement objectives and other considerations agreed to by the Panel.

c) Any changes from PSC staff recommendations for points 1) a) and 1) b) above shall be based on bilateral agreement between the National Sections of the Fraser Panel. Acceptance of the PSC staff recommendation requires approval of at least one of the National Sections.

d) The respective National Sections of the Panel will develop proposed regulations for their domestic Panel Water fisheries consistent with recommendations and projections provided by the PSC staff as described in 1) a) and 1) b) as may be modified pursuant to 1) c). Either National Section may ask PSC staff for advice in designing its fisheries proposals. PSC staff will assess whether proposed fishery regulations for Panel Waters are consistent with recommendations and projections described in 1) a) and 1) b) and Panel objectives. If proposed fishery regulations are assessed to be consistent, the Fraser River Panel will adopt the Panel Water fishery recommendations. If the PSC staff advises that a Panel Water fishery proposal is inconsistent with 1) a), 1) b), or Panel objectives, then either: (1) the Panel may adopt the proposal based on bilateral agreement or; (2) the proposing National Section may modify and re-submit its proposal.

2) Review of Improvements in Fraser River Panel Process

Following the 2002 management season, and by the February 2003 Pacific Salmon Commission Annual Meeting, the Fraser River Panel will provide a report to the Pacific Salmon Commission that includes the following:

a) a review of the outcomes and merits of the above modifications to the Fraser River Panel process in 2002; and

b) the review will consider a provision that, after receiving Canada's pre-season forecasts, the PSC staff will make recommendations to the Fraser River Panel on how the pre-season forecasts should be used in in-season management beginning in 2003,

c) based on the experience of the 2002 season and subject to a positive review agreeable by both National Sections, the Panel shall make recommendations to the Commission for appropriate changes to the Chapter 4 Annex IV provisions and / or the Fraser River Panel guidance provided herein.

Computation of Fraser River Sockeye Salmon Total Allowable Catch (TAC)

1) The U.S. overage for 2000 is 56,000 Fraser River sockeye.

2) The U.S. overage for 2001 is deemed to be zero.

3) Fraser River sockeye. For 2002, for the purpose of computing the TAC for sharing purposes, the Panel shall define the TAC as the aggregate Fraser River sockeye runs (including any catch of Fraser River sockeye identified in Alaskan waters) after the spawning escapement targets established pre-season by Canada (subject to any adjustments specified in paragraph 3(b) of Annex IV), the agreed Fraser River Aboriginal Exemption, and the catch in Panel authorized test fisheries have been deducted.

4) For the purpose of paragraph 8 of Annex IV, except as provided in (5) below, only the U.S. share will be adjusted and only for any harvest overage of the U.S. share in 2002 and in a manner consistent with paragraph 8.

5) In 2002, if in-season the catch in Canada directly impedes the U.S. pursuing its in-season TAC, this circumstance will be noted in-season by the Panel including the effect Canada's catch had on impeding the U.S. pursuit of its in-season share, and will be compensated for pursuant to paragraph 8 of Annex IV.

Chapter 4: Fraser River Sockeye and Pink Salmon

1. The provisions of this Chapter shall apply for the period 2005 through 2010.

2. The U.S. share of the annual Fraser River sockeye and pink salmon Total Allowable Catch (the "TAC"), as defined in paragraph 3 to be harvested in the waters of Washington State is as follows:

   (a) for sockeye salmon, the U.S. catch in the Fraser Panel Area shall not exceed 16.5 percent of the TAC;

   (b) for pink salmon, the U.S. catch in the Fraser Panel Area shall not exceed 25.7 percent of the TAC.

3. For the purpose of this Chapter, the TAC shall be defined as the remaining portion of the annual aggregate Fraser River sockeye and pink runs (including any catch of Fraser River sockeye identified in Alaskan waters) after the spawning escapement targets established, unless otherwise agreed, by application of Canada's pre-season escapement plan (subject to any adjustments made pursuant to paragraph 3(b), below), the agreed Fraser River Aboriginal Exemption, and the catch in Panel authorized test fisheries have been deducted. TAC shall be computed separately for Fraser River sockeye and pink salmon. The following definitions and procedures apply to TAC calculations:

   (a) The annual U.S. share shall be computed based on the in-season run size estimates in effect at the time the Panel relinquishes control of the U.S. Panel waters, using the escapement targets established by application of Canada's preseason escapement plan as may be adjusted pursuant to paragraph 3(b), below, and taking into account any adjustments as provided in paragraph 8, below.

   (b) For the purposes of in-season management by the Fraser River Panel, the spawning escapement objective is the target set by Canada, including any extra requirements that may be identified and agreed to by the Fraser River Panel, for natural, environmental, or stock assessment factors, to ensure the fish reach the spawning grounds at target levels. In the event the Fraser River Panel does not agree to additional escapement amounts, the PSC staff will make a recommendation which shall become effective upon agreement by at least one national section of the Panel. Any additional escapement amounts believed necessary by Canada above those determined pursuant to the foregoing will not affect the U.S. share.

   (c) The agreed Fraser River Aboriginal Fishery Exemption (AFE) is that number of sockeye which is subtracted from the total run size in determining the TAC upon which the U.S. shares specified in paragraph 2 are calculated. Any Canadian harvests in excess of these amounts count against the TAC, and do not affect the U.S. share. The agreed Fraser River Aboriginal Fishery Exemption is the actual catch of Fraser River sockeye harvested in both the in-river and marine area Aboriginal Fisheries, up to 400,000 sockeye annually.

   (d) For computing TAC by stock management groupings, the AFE shall be allocated to management groups as follows: The Early Stuart sockeye exemption shall be up to 20% of the Fraser River Aboriginal Fishery Exemption (AFE), and the remaining balance of the latter exemption shall be based on the average proportional distribution for the most recent three cycles and modified annually as required to address concerns for Fraser River sockeye stocks and other species and as otherwise agreed by the Fraser River Panel. For the duration of this Chapter, the harvest distribution of Early Stuart sockeye is expected to remain similar to that of recent years.

(e) To the extent practicable, the Fraser River Panel shall manage the United States fishery to spread the United States harvest proportionately to the TACs across all Fraser River sockeye stock management groupings (Early Stuart, Early Summer, Mid-Summer, and Late Run).

4. Pursuant to Article IV, paragraph 3, Canada shall annually establish the Fraser River sockeye and pink salmon spawning escapement targets for the purpose of calculating the annual TAC. For the purposes of pre-season planning, where possible, Canada shall provide forecasts of run size and spawning escapement requirements by stock management groupings to the Fraser River Panel no later than the annual meeting of the Commission. Forecasts of migration patterns, gross escapement needs, and any in-season adjustments in escapement requirements shall be provided to the Fraser River Panel by Canada as they become available in order to accommodate the management needs of the Panel in a timely manner. In addition, on a timely basis, the United States shall provide forecasts of sockeye and pink salmon run size returns affected by Panel management.

5. The Fraser River Panel will develop fishing plans and in-season decision rules as may be necessary to implement the intent of this Chapter. The Parties shall establish and maintain data sharing principles and processes which ensure that the Parties, the Commission, and the Fraser River Panel are able to manage their fisheries in a timely manner consistent with this Chapter. With respect to management responsibilities, all activities of the Parties and the Fraser River Panel shall be consistent with the August 13, 1985, Memorandum of Understanding between the Parties.

6. Fraser River Panel pre-season planning meetings that do not occur simultaneously with Commission meetings shall be held alternately in Canada and the United States. Scheduled in-season management meetings shall be held at Richmond, B.C. unless the Panel agrees otherwise. As agreed, Panel meetings may be held by telephone conference call.

7. The Parties may agree to adjust the definition of the Fraser Panel Area as necessary to simplify domestic fishery management and ensure adequate consideration of the effect on other stocks and species harvested in the Area.

8. Annually, the U.S. share shall be adjusted for harvest overages and underages in accordance with guidance provided by the Commission.

9. The Parties shall establish a Technical Committee for the Fraser River Panel:

   (a) the members shall coordinate the technical aspects of Fraser River Panel activities with and between the Commission staff and the national sections of the Fraser River Panel, and shall report, unless otherwise agreed, to their respective National Sections of the Panel. The Committee may receive assignments of a technical nature from the Fraser River Panel and will report results directly to the Panel.

   (b) membership of the Technical Committee shall consist of up to five such technical representatives as may be designated by each National Section of the Commission.

   (c) members of the Technical Committee shall analyze proposed management regimes, provide technical assistance in the development of proposals for management plans, explain technical reports and provide information and technical advice to their respective National Sections of the Panel.

   (d) the Technical Committee shall work with the Commission staff during pre-season development of the fishery regime and management plan and during in-season consideration of regulatory options for the sockeye and pink salmon fisheries of Fraser Panel Area waters and during post-season evaluations of the season to ensure that:

      (i) domestic allocation objectives of both Parties are given full consideration;

(ii) conservation requirements and management objectives of the Parties for species and stocks other than Fraser River sockeye and pink salmon in the Fraser Panel Area during periods of Panel regulatory control are given full consideration; and

(iii) the Commission staff is informed in a timely manner of management actions being taken by the Parties in fisheries outside of the Fraser Panel Area that may harvest sockeye and pink salmon of Fraser River origin.

(c) the staff of the Commission shall consult regularly in-season with the Technical Committee to ensure that its members are fully informed in a timely manner on the status of Fraser River sockeye and pink salmon stocks, and the expectations of abundance, migration routes and proposed regulatory options, so the members of the Technical Committee can brief their respective National Sections prior to each in-season Panel meeting.

10. The Parties agree that Panel management actions should meet the following objectives, listed in order of priority:

(a) obtain spawning escapement goals by stock or stock grouping;

(b) meet Treaty defined international allocation; and

(c) achieve domestic objectives.

11. The Fraser River Panel shall manage its fisheries consistent with the provisions of the other chapters of Annex IV to ensure that the conservation needs and management requirements for other salmon species and other sockeye and pink salmon stocks are taken into account.

12. The Parties agree to develop regulations to give effect to the provisions of the preceding paragraphs. Upon approval of the pre-season plan and during the period of Panel regulatory control, all sockeye and pink fisheries under the Panel's jurisdiction are closed unless opened for fishing by in-season order of the Panel.

13. Pursuant to the Parties' obligations under Article VI the Panel will use the following in-season decision process:

(a) The mid-point forecast provided by Canada will be used for management purposes until in-season updates of run size become available. Based upon advice from the Fraser River Panel Technical Committee and PSC staff, the Panel may adopt a more precautionary or optimistic applications of the forecast information until in-season updates of run size are available. PSC staff will provide the Fraser River Panel with recommendations for in-season run size and other factors relevant to sound fisheries management decisions. Based on information such as, but not limited to, in-season estimates of run timing and diversion rate, the PSC staff will make recommendations to the Fraser River Panel regarding in-season decision making.

(b) PSC staff will provide the Fraser River Panel with projected harvestable surpluses and status of harvest from fisheries under Panel management. These projections will incorporate any Fraser River Panel agreement on management adjustments that deal with environmental conditions during in-river migration that could significantly impact the Fraser River Panel's ability to achieve spawning escapement objectives and other considerations agreed to by the Panel.

(c) Any changes from PSC staff recommendations for points 13(a) and 13(b) above shall be based on bilateral agreement between the National Sections of the Fraser Panel. Acceptance of the PSC staff recommendation requires approval of at least one of the National Sections.

(d) The respective National Sections of the Panel will develop proposed regulations for their domestic Panel Water fisheries consistent with recommendations and projections provided by the PSC staff as described in 13(a) and 13(b) as may be modified pursuant to 13(c). Either National Section may ask PSC staff for advice in designing its fisheries proposals. PSC staff will assess and provide advice as to whether proposed fishery regulations for Panel Water fisheries are consistent with recommendations and projections described in 13(a) and 13(b) and Panel objectives. Subsequently, after full discussion of a Panel water fishery proposal, the following may occur: (i) the Panel may adopt the proposal based on bilateral agreement or; (ii) the proposing National Section may modify and re-submit its proposal in response to advice from staff and/or concern(s) raised by the other National Section; or (iii) while acknowledging objection(s) of the other National Section, the Panel will grant the request to adopt the fishery proposal. In the event that the Panel adopts a fishery under the provisions of the latter circumstance (13(d)(iii)), prior to the commencement of the proposed fishery, the proposing National Section must provide a written rationale for the fishery as submitted.

(e) If post-season a party maintains that it has been adversely affected by a fishery they objected to pursuant to paragraph 13(d)(iii) above or paragraph 13 (f) below; the PSC staff will prepare an objective report on the circumstances of the fishery and its consequences for the January PSC meeting following the season in question. The Panel will review the staff report and determine what action is required. If the Panel cannot come to agreement on the appropriate action, the issue will be referred to the Commission for resolution during its February annual meeting.

(f) Pursuant with Article VI, paragraph 7 of the treaty, the Parties will communicate and consult with one another in a timely manner regarding their fishing plans for Fraser River sockeye outside of the Panel's regulatory control. In the event that a party has an objection to the other party's fishing plans as they relate to achievement of Panel objective, the implementing party will provide the rational for such plans.

APPENDIX D: COMMISSION GUIDANCE TO THE FRASER RIVER PANEL, FEBRUARY 18, 2005

Commission Guidance to the Fraser River Panel

The purpose of this document is to provide Commission direction to the Fraser River Panel with respect to implementation of Paragraph 8 of Chapter 4, Annex IV of the Pacific Salmon Treaty.

1. Annually, the U.S. share shall be adjusted for harvest overages and underages as follows:

   (a) The U.S. share shall be adjusted in the amount of any harvest overage or underage of the same species from the previous year or years as provided in subparagraphs 1(b) and 1(c), below. In making such adjustment, the U.S. current year share will not be reduced by more than 5 percent nor increased by more than 15 percent because of the adjustment, unless otherwise agreed. The Fraser River Panel shall attempt to fully implement any adjustments to the U.S. share by the expiration of this Chapter. Any remaining balance from the harvest overage or underage shall be incorporated in the subsequent year's allocation. Any residual overage or underage remaining at the last year of this Chapter shall be carried forward into the next Chapter period.

   (b) The U.S. share will be adjusted to account for management imprecision in U.S. fisheries or changes in the TAC which are identified in-season but too late to address in that year's fishery subject to the underage limitation prescribed in subparagraph 1(c). Additionally, the U.S. share will be adjusted for underages which occur as a result of Canada directly impeding the U.S. from pursuing its in-season share of the TAC. This latter circumstance will be noted in-season by the Panel including the effect Canada's catch had on impeding the U.S. pursuit of its in-season share, and will be compensated for as an underage pursuant to paragraph 1(a).

   (c) The U.S. share will not be adjusted:

      (i) for underages which occur because the U.S. fishery failed to deploy sufficient effort;

      (ii) for underages which occur because too few fish were available to the U.S. fishery due to migration patterns (e.g., diversion rates) or harvesting constraints for intermingled stocks or species; or

      (iii) for that portion of an underage resulting from an increase in the estimated TAC identified after the year's fishery has ended but which would not have been available due to harvest constraints for intermingled stocks or species.

2. The Fraser River Panel shall develop agreed procedures for implementing this guidance as part of its preseason planning process.

APPENDIX E: LATE-RUN SOCKEYE STUDIES IN 2002

(Note: information in this Appendix was extracted from information posted on the PSC's website relating to a July, 2003 update on the Late-run sockeye studies)

Introduction

Background

Late-run sockeye have historically delayed in the lower Strait of Georgia for four to six weeks prior to entering the Fraser River en route to their spawning grounds. Since 1996, Late-run sockeye (excluding Birkenhead sockeye) have often entered the Fraser River with little or no delay, which has resulted in mortality rates of some Late-run sockeye stocks exceeding 90% in some years. The cause(s) of this early entry behavior have not yet been identified, despite intensive and on-going research studies. Some of the most serious implications of this early entry behavior of Late-run sockeye are that: (1) the future viability of some Late-run stocks may be jeopardized; and (2) substantially lower harvest rates on Late-run and Summer-run sockeye (a portion of which overlap in their migration timing with Late-run fish) have been necessary in recent years to help ensure that Late-run sockeye stocks are conserved. The greatly reduced harvest rate on Fraser River sockeye is having significant adverse impacts on the multitude of commercial and non-commercial users of this resource. The severe curtailment of harvest has been necessary to protect the sustainability of Late-run stocks, including the famous Adams River sockeye run.

Migration Behavior of Late-run Fraser River Sockeye in 2002

In 2002, as in recent past years, early entry of Late-run Fraser River sockeye stocks into the Fraser River occurred. The Late-run return was predominantly comprised of Late Shuswap sockeye, since 2002 is the dominant cycle line return for the famed Adams River sockeye population. Late-run sockeye were first identified in DNA analyses of sockeye tissue samples collected from the Whonnock gillnet test fishery (Fraser River, Area 29-16) on July 27 and 28, which confirmed the continuation of the early upstream migration behavior. However, as the migration progressed, marine assessments indicated that a substantial portion of the run was delaying in the Strait of Georgia. This was different from their behavior in 2000 and 2001, when virtually all Late-run fish entered the Fraser River without delay, and approximately 90% of these fish died prior to spawning.

As the Late-run sockeye migration progressed through August, an increasing component of the run showed a normal behavior pattern, and delayed in the Strait of Georgia. The delaying fish began migrating in large numbers into the Fraser River in early September, when an estimated 1,200,000 Late-run sockeye migrated past Mission between August 30 and September 5. The migration tapered off for a few days, and then a larger second group of Late-run fish began migrating past Mission where the Pacific Salmon Commission maintains a hydroacoustic monitoring station. Between September 11 and September 20, an additional 3,600,000 Late-run fish were estimated migrating past Mission. The run had virtually completed its upstream migration by September 24. The date when 50% of Late-run sockeye were estimated to have migrated past Mission was September 12, which is approximately two weeks earlier than the long-term average date.

The entry pattern of Late-run sockeye into the Fraser River in 2002 was similar to the 1998 brood year when significant early upstream migration occurred in August, followed by a strong surge of escapement between September 12 and 17, and very low escapement after September 20. The 50% upstream migration date of Late-run sockeye passing Mission in 1998 was September 14, and approximately 36% of Late Shuswap sockeye were estimated to have died en route between Mission and their natal spawning areas. In 2002, with a 50% migration date past Mission that was two days earlier (September 12), a much smaller fraction of the run died en route (less

than 10% based on comparison of hydroacoustic estimates of Late-run sockeye passing Mission and upstream accounting estimates from spawning grounds).

The Pacific Salmon Commission (PSC) funded several studies in 2002 directed at improving understanding of the dynamics of the early upstream migration behavior of Late-run sockeye, and at testing hypotheses to determine mechanisms causing the abnormal behavior of Late-run sockeye observed in recent years. The research plan was coordinated by the Committee on Scientific Cooperation (CSC) of the PSC, with total funding of approximately $1,000,000 (Cdn.) contributed by the Canadian and United States governments. A summary of the research conducted in 2002 is presented below:

Summary of Studies Conducted on Late-run Fraser River Sockeye in 2002

Telemetry/Disk Tagging

Tagging objectives:

1. Determine if Late-run sockeye enter the river in the same chronological order as they arrive in ocean approach areas.
2. Estimate the amount of delay of Late-run sockeye in the Strait of Georgia by timing group.
3. Estimate in-river survival and spawning success of Late-run sockeye by timing group.

Nearly 900 radio-tagged Fraser River sockeye were released in ocean approach areas. Late-run sockeye accounted for 50% of the releases. Tagged Late-run sockeye were released in early, mid and late timing groups in both Johnstone and Juan de Fuca straits. An additional 170 radio-tagged fish were released in the Thompson River near Ashcroft (approximately 35 km downstream from Kamloops Lake) along with about 20,000 disk-tagged fish in early, mid and late-timed groups.

Results:

- The survival rates of radio-tagged fish released in the marine areas varied among the six time-area release groups. Estimates of survival from the telemetry data in four of the six groups ranged from 73-75%. These survival estimates are consistent with other marine tagging studies. For the remaining two groups, only 36% of the radio-tagged fish survived and were accounted for in the Fraser River.
- The reason for the low survival rates in two of the time-area marine release groups is unknown. Both releases occurred at times when the abundance of sockeye in the release areas was low based on DFO and PSC test fishing data. It is unclear if tagging effects reduced the survival of tagged fish. All radio-tagged fish were also tagged with an external orange "spaghetti" tag possibly making them more vulnerable to predation in areas of low sockeye abundance. Alternatively, the hypothesis that low survival of both tagged and untagged fish occurred in these areas and times cannot be rejected.
- Marine-tagged Summer-run sockeye (as identified through DNA analysis) generally entered the Fraser River in the same chronological order as they were tagged. For combined releases in Johnstone Strait and Juan de Fuca Strait, the travel times between release location and Mission for the 1st, 2nd and 3rd release timing groups were similar.
- River entry timing of marine-tagged Late-run fish was more variable and protracted compared to Summer-run fish. On average, Late-run fish had travel times from release locations to the lower Fraser River of about 3 weeks compared to one week for Summer-run fish.
- Some Late-run sockeye from each release group entered the Fraser River with little or no delay in the Strait of Georgia and at the same time as the Summer-run. Of the three release groups, higher proportions (51%) of Late-run sockeye in the 1st group entered the river early. The proportion that entered early declined in the 2nd (11%) and 3rd (10%) release groups. The amount of delay declined successively between the 1st, 2nd and 3rd release groups.
- In-river survival in 2002, which excludes pre-spawn losses in terminal spawning areas, was similar in each of the three Summer-run release groups. In contrast, the in-river survival of Late-run fish varied from 59% in the 1st release group to 88% for the 3rd release group. These survival estimates in 2002 were higher than estimates based on Mission acoustic abundance

estimates of Weaver Creek sockeye in 2000 and 2001 when survival was estimated at about 10%.

- In-river survival was very poor for Late-run fish that entered the river earliest. Late-run sockeye that passed Mission before August 18, 2002 had an in-river survival rate of 11%, whereas after September 11 the survival rate was 92%.
- The overall survival rate from Mission to the spawning areas, excluding likely in-river fishery removals, was 80% for Late-run sockeye and 92% for Summer-run fish.
- The radio telemetry data for Late-run sockeye suggests a relationship between river entry timing and survival from Mission to the spawning grounds for Adams and Lower Shuswap river sockeye.
- A curve describing the in-river survival, excluding pre-spawn losses at terminal spawning sites, by time of river entry based on telemetry data reveals an increase in survival with date of passage. Late-run sockeye that passed Mission before August 18, 2002 had an in-river survival rate of 13%. Survival rates increased rapidly for Late-run sockeye that passed Mission from late-August to early September. Late-run sockeye that passed Mission after September 11 had a survival rate of 92%.
- It is important to note that the sample size of Late-run sockeye that passed Mission before August 18 was low (15 fish). Consequently, the in-river survival estimate for the early entry group had low precision and was potentially inaccurate.
- The trend in survival over time of radio-tagged fish and disk-tagged fish was similar with lower survival in the early-timed portion of the Late-run return.
- The low numbers of radio-tagged carcasses recovered from spawning sites precluded rigorous evaluation of spawning success by timing group based on radio-tag recoveries.
- The large number of disk-tagged carcasses recovered from spawning sites provided sufficient data to estimate spawning success by tag-release timing group.
- The disk tagging results indicate that the Late-run fish tagged at Ashcroft early in the run (before August 26) had the highest pre-spawn mortality rate (70%). In contrast, the pre-spawn mortality rate was less than 3% for fish that were tagged at Ashcroft after September 30.
- Combining estimates of en route mortality and pre-spawn mortality by timing group is required to estimate the overall survival from river entry to spawning by timing group. The overall survival estimates for the Adams/Shuswap Late-run sockeye ranged from 4% for fish that passed Mission before August 18 to 90% for those that passed Mission after September 11.

Physiology

Osmoregulation

Salmon must undergo a number of physiological adjustments prior to initiating their migration into freshwater from the ocean, including a change in kidney function to expel surplus water from the blood. These physiological adjustments are necessary to maintain osmoregulatory function in the fish. Plasma and gill samples were used to assess osmoregulatory function. Samples were collected off southwest Vancouver Island near Port Renfrew, in the Strait of Georgia and in the lower Fraser River in 2002.

Hypothesis 1: Osmoregulatory adaptation to freshwater has been triggered earlier than normal, forcing Late-run sockeye to enter the Fraser River early.

Hypothesis 2: In-river mortality of early entrants is higher than normal because fish that enter early are not fully prepared physiologically for freshwater, leading to osmoregulatory dysfunction and premature death, especially if fish are stressed.

Hypothesis 3: The early entry of Late-run sockeye, combined with prolonged freshwater residence and the full development of kidney parasitic infection leads to pre-spawning mortality, particularly if fish enter the river unprepared for osmoregulation in freshwater.

Results:

- The 2002 results indicated that based on the physiological traits assessed, both Summer and Late-run fish were already in the process of preparation for freshwater at both marine locations. This implied that adaptation for freshwater started seaward of Port Renfrew.
- Samples taken in the Georgia Strait showed a bimodal distribution in the traits measured, which suggested two groups of freshwater preparation levels. Both groups of fish holding in the Strait of Georgia would be seawater tolerant under low stress conditions.
- Experimental evidence from the Late-run Adams River fish held at the Shuswap hatchery showed that sockeye holding at higher temperatures had an accelerated decline in osmoregulatory function compared to fish holding in cooler water.
- The initial hypotheses that early entry into the Fraser River is related to osmoregulatory dysfunction cannot be rejected, but could be properly tested if blood samples were collected from radio-tagged fish that were subsequently released into the ocean.

Reproduction:

Reproductive hormones play a key role in gonad maturation rates and may be important for determining the timing of migration into freshwater.

Hypothesis 1: Late-run fish enter the Fraser River early due to an advanced state of maturity and early entry fish have lower reproductive success.

Hypothesis 2: Early entry fish wait on the spawning ground because the hormones related to final sexual maturation are no longer synchronized to arrival at the spawning ground.

Results:

- Ovary mass for both Summer-run and Late-run sockeye increased with date of river entry and proximity to the spawning grounds. There was a fixed rate of egg development with distance traveled upstream. This was consistent with studies of other sockeye populations.
- The hypothesis that early entry Late-run sockeye are more mature based on ovary mass alone was rejected.
- Further analyses of factors affecting gonad development should consider issues such as body energy reserves and reproductive hormone levels.
- There was no temporal difference in final ovary mass or egg size among the different timing groups for both Summer-run and Late-run sockeye. In general, Adams sockeye had high fertilization success (>90%) throughout the spawning period, regardless of spawning date.
- The surviving sockeye that were sampled in 2002 were healthy and had high reproductive success, regardless of entry timing. The hypothesis that early entry fish have a lower reproductive success was not supported by the 2002 results. However, the very early entrants to the spawning grounds were not assessed for fertilization success.

Energetics:

As adult sockeye approach the Fraser River, they stop feeding in marine areas. They also do not feed during in-river migration. Salmon therefore have limited energy to complete development of gonads and their spawning migration. In recent years, body energy reserves in Fraser sockeye have been low compared to earlier years.

Hypotheses: Late-run stocks are ascending the river earlier than normal due to low initial somatic energy reserves (i.e., they may have low stores of fatty tissue, and since they do not feed during their up-river migration they may be more susceptible to dying prior to spawning).

Results:

- Fraser sockeye energy states were assessed in 2002 by researchers from the University of British Columbia.

- The results to date indicate that early-timed fish have greater energy reserves than later-timed fish. However, there is some evidence that early-timed fish use energy less efficiently than later-timed fish during their migration.
- The trade-off between metabolic energy required to sustain life and gonad development required for reproduction was identified as a confounding effect in the preliminary analysis. The recommendation from their work was to integrate the energy work with other physiological and parasite measures.
- At present it is not possible to refute or support the hypotheses that early entry into the Fraser River is due to low initial energy reserves or that they are dying in large numbers before spawning because of energy depletion. Experiments planned for 2003 should provide additional information to examine these hypotheses.

Parasitology

Hypothesis: Mortality from *Parvicapsula minibicornis* infection is highest in early entry Late-run fish compared to late-entry fish. Early-entry fish remain in the Fraser watershed longer that late-entry fish and are therefore more prone to severe *Parvicapsula* infection.

Results:
- *Parvicapsula* incidence rates in 2002 were similar to 2001 and approached 100% in sockeye samples from both Summer-run and Late-run sockeye at the end of the spawning migration. The high incidence of infection but lower mortality rates in 2002 compared to earlier years indicated that infected fish do not necessarily die when infected.
- The severity of *Parvicapsula* infection and mortality rate was dependent on environmental conditions. Holding studies indicate higher severity and higher mortality with increased temperature. At the highest exposure temperatures in the holding studies, the severity of infection increased to near-lethal levels.
- A bimodal pattern of *Parvicapsula* infection severity was observed in which samples collected from the Adams River showed early and late peaks of severity. This suggested two patterns of salmon migratory behavior: (1) late river-entry, leading to reduced in-river residence and low infection severity, and (2) early river-entry, leading to greater in-river residence and greater infection severity. It was predicted that en route and/or pre-spawn mortality was higher in the latter group and it was supported by the tagging data.

Oceanography

Hypotheses: Early entry is dependent on upper ocean conditions in ocean migratory areas as adults enter the Strait of Georgia. In-river mortality is related to the productivity regime experienced in the ocean-entry-year of juvenile sockeye.

Environmental variables were used to assess processes affecting migration timing based on the concept that the upper layer of the Strait of Georgia system is, to varying degrees, an extension of the Fraser River estuary. This has been called the "Brackish Layer Depth Model" and focuses on environmental conditions in near-surface depths where salmon migrate. A second approach is investigating the influence of ocean productivity regimes and first-year marine growth of sockeye to explain variations in in-river mortality.

Results:
- For specific time periods, there are significant statistical correlations between the sockeye return time series and *individual* physical variables (specifically, the variability of surface temperature and salinity) in the Georgia Basin.
- For specific time periods, there are significant statistical correlations between the sockeye return time series and physical variables after accounting for the proportion of sockeye that migrate either through Johnstone Strait or Juan de Fuca Strait.
- High variability in temperature and salinity implies that river water is retained as a layer. Low variability implies vertical mixing, and low retention of freshwater.

- The individual environmental variables were combined in a statistical analysis that assessed the overall effect of environmental variables. The analysis revealed that the return timing was correlated with overall temporal variability derived from sea-surface temperature, sea-surface salinity, river discharge, wind stress, water levels, and other variables for the Georgia Basin.
- The combined effect of the individual environmental variables was consistent with results based only on the individual variables. The dominant variables retained their importance regardless of where they are measured in the basin.
- The analysis also revealed that long-term effects of the combined environmental variables were correlated with the *Pacific Decadal Oscillation* (PDO) Index. This indicates a strong link between return timing and decadal-scale ENSO-type warming/cooling in the North Pacific.
- There appears to be distinct climate regimes or low-frequency climate cycles that are related to variations in the survivability of Late-run Fraser River sockeye. For example, Fraser sockeye were characterized by low survival in the 1990s. Late-run in-river mortality was also high for fish from brood years 1991-1997.
- Decadal-scale climate regimes identified from large-scale environmental indices resulted in different relationships between the abundance of spawners and future recruitment.
- Climate regimes affect 1st year marine growth of sockeye. The hypothesis proposes that if 1st year marine growth conditions are good then sockeye would be able to withstand environmental factors affecting early river entry and in-river survival.

Other Hypotheses

Two additional hypotheses were considered. The potential effect of chemical contaminants on early entry and subsequent mortality were assessed. Samples were collected in 2002 but they have not been fully analyzed. Another hypothesis considered in 2002 was that marine mammal (killer whales, seals and sea lions) activity near the Fraser River estuary forced sockeye into the river earlier than normal. Marine mammal effects were considered a lower priority for research and therefore marine mammal studies were not undertaken in 2002.

An important conclusion from the 2002 studies was that environmental conditions in the river potentially affect survival rates of early-entry fish. Premature death of highly stressed fish could be from several factors including predation, physiological dysfunction, energy depletion or disease (i.e., *Parvicapsula* infection). Conditions in 2002 were favourable during the migratory period of Late-run sockeye compared to other years. The average in-river survival rate of Late-run sockeye was higher in 2002 than in 2000 and 2001. Nevertheless, the early entry phenomenon persisted in 2002 and the early entrants of Late-run sockeye had a low survival rate (13%) compared to later entry groups of Late-run sockeye (92%). Combining the estimates of in-river survival with terminal area pre-spawn losses reduced the overall survival rate of early entry Late-run sockeye to 4%.

The tagging studies were designed to estimate timing and survival rates rather than to test specific hypotheses on the causes of early migration. A new hypothesis to explain the early entry of Late-run sockeye, however, has been proposed based on results of the telemetry study. The hypothesis proposes that selective pressure to school ("stay with the school hypothesis") would result in a substantial portion of the Late-run fish entering the Fraser early with the Summer-run fish when the latter are numerically dominant. During time periods or years when Late-run sockeye were numerically dominant, the migratory behavior of Summer-run sockeye would not have a significant influence on the genetically programmed delay behavior of Late-run sockeye. If early entry of Late-run fish is controlled to some extent by the relative abundance and timing overlap with Summer-run stocks, then the potential for early entry and lower in-river survival would be highest in years like 2000 and 2001. The Late-run stocks were relatively small compared to Summer-run sockeye in those years and there was almost complete overlap in the marine migration timing of Summer-run and Late-run stocks. This theory can be tested to some degree using historical data. Recent advances in DNA analyses may be able to provide the in-season data required to assess the potential for early entry and make the appropriate adjustments to the pre-season expectations regarding in-river survival rates. The evidence in support of this hypothesis should eventually be considered along with the evidence supporting competing hypotheses.

APPENDIX F: 2002 FRASER RIVER PANEL MANAGEMENT PLAN PRINCIPLES AND CONSTRAINTS

2002 FRASER RIVER PANEL MANAGEMENT PLAN PRINCIPLES AND CONSTRAINTS

1. Fisheries and Oceans Canada (DFO) have provided the Panel with run-size forecasts for Fraser River sockeye by run timing group. For pre-season planning purposes, the Panel used the 50% and 75% probability (p) levels of abundance. At the 75% p level, there is a 75% probability that the return will reach or exceed 7,911,000 fish. At the 50% p level, there is a 50% probability that the return will reach or exceed 13,365,000 fish.

2. The Panel has adopted a precautionary management policy for Late-run sockeye and therefore will manage on the presumption that similar to recent years, Late-run sockeye (excluding Birkenhead) will enter the Fraser River early and a significant proportion will not survive to spawn. Early Summer-run, Summer-run and Late-run sockeye will be managed consistent with the Panel agreed guidelines of May 22, 2002 (see attached).

3. The 1999 Annex IV, Chapter 4, of the Pacific Salmon Treaty limits the United States harvest (in Washington State) to 16.5% of the total allowable catch (TAC) of Fraser River sockeye salmon, while the Canadian share of the TAC is 83.5%. The United States' share will be reduced by up to 56,000 fish due to a catch overage in 2000, as per the Pacific Salmon Commission agreement of June 12, 2002 (see attached).

4. The Panel has adopted a 50% probability level forecast for Late-run sockeye for use in planning fisheries. When sufficient information is available, the Panel will change the run size of Late-run sockeye in-season.

5. Panel Water fisheries directed at Summer-run sockeye will commence subject to stock proportions, migratory abundance levels, and escapement levels of both Summer-run and Early Summer-run stocks being judged consistent with expectations.

6. Panel Water fisheries directed at Summer-run sockeye will cease either when the Late-run exploitation rate ceiling, or the Panel agreed cut-off date (approximately mid-August) is reached (which ever occurs sooner); subject to careful review of in-season assessment data.

7. In-season decisions of the Panel will follow policy guidance outlined by the Pacific Salmon Commission agreement of June 12, 2002 (see attached).

REGULATIONS

1. If the abundance of Early Summer-run sockeye salmon is approximately at the 50% probability level (678,000 fish) and the abundance of Summer-run sockeye salmon is approximately at the 50% probability level (9,006,000 fish) and the runs arrive at near normal dates, fisheries would be expected to commence as follows: United States Areas 4B, 5, and 6C – week of July 21-27; Areas 6, 7 and 7A week of July 28-August 3; Canadian Area 20 – week of July 28-August 3; Areas 18 and 29 – week of July 28-August 3.

2. If the abundance of Early Summer-run sockeye salmon is approximately at the 75% probability level (326,000 fish) and the abundance of Summer-run sockeye salmon is approximately at the 75% probability level (5,204,000 fish) and the runs arrive at near normal dates, fisheries would be expected to commence as follows: United States Areas 4B, 5, and 6C – week of July 28-August 3; Areas 6, 7 and 7A week of August 4-10; Canadian Area 20 – week of July 28-August 3; Areas 18 and 29 – week of July 28-August 3.

3. The Parties' conservation concerns for other species and stocks will be taken into account throughout the 2002 management season.

APPENDIX G: GUIDELINES FOR PRE-SEASON FRASER SOCKEYE FISHING PLANS TO ADDRESS LATE-RUN CONCERNS

GUIDELINES FOR PRE-SEASON FRASER SOCKEYE FISHING PLANS TO ADDRESS LATE RUN CONCERNS

The 2002 cycle is the dominant cycle for Adams River sockeye. Management actions/objectives implemented in 2002 will be designed to preserve future options to maintain this stock's status. A coordinated approach to management will be developed that will see that the Parties share the burden of conservation. The harvest of Early Summer and Summer stocks will be shared in a manner consistent with PST Chapter 4 Annex IV.

The Fraser Panel will develop a fishing plan that incorporates these guidelines and other specific provisions that are identified and adopted to meet the Panel's objectives.

ASSUMPTIONS

1. For all fisheries planning purposes, late run sockeye are assumed to continue the early upstream migration behaviour and associated en-route and pre-spawn mortality.
2. The capability to assess key parameters in-season, such as run size, timing etc., is good quality for Summer runs and of poor quality for late runs.
3. An approach to management that is responsive to in-season information will guide the FRP in 2002 in order to achieve its objectives.
4. The preseason fishing plan will assume a 16 (historical average timing) day timing separation between Summer and Late runs.

ELEMENTS OF THE PLAN

- Based upon preseason information and assumptions: No directed fisheries will occur on late runs.
- Minimize incidental impacts on late runs in all fisheries.
- Develop fishing plans that direct harvests on available surpluses of Early Summer and Summer run sockeye, and attempt to distribute harvest evenly over the Early Summer run.
- The intent of the 2002 fishing plan and in-season actions will be to limit the total fishery exploitation rate of late run sockeye, excluding the Birkenhead stock to 15%. The U.S. and Canada will respectively limit incidental fishery impacts to 16.5% and 83.5% of the residual of the 15% Late run sockeye harvest rate limit (excluding Birkenhead) after accounting for PSC sanctioned test fisheries and in fisheries covered under the 400,000 Aboriginal Fisheries Exemption.
- Develop adaptive in-season decision rules that respond to variations in timing (i.e. overlaps), run sizes and delay of late runs off the mouth of the Fraser River to the extent that this information would be available.
  - Although estimates of the late run exploitation rate may be available in-season, they may not be timely or reliable. Therefore, to effect the timely management of sockeye in marine waters, the Fraser Panel may have to use other indicators which can be used as surrogates to achieve the overall exploitation rate limit for late run sockeye, excluding Birkenhead sockeye. The staff and technical committee will evaluate such in-season management tools as stock proportions and fishery cut-off dates that could be used to meet this objective and make appropriate recommendations to the Panel.
- The Summer run will be managed to meet spawning escapement targets and harvests will be based on the pre-season forecast and in-season updates of run size. If the Summer run timing overlaps Late run to an extent larger than the pre-season expectation would indicate, full harvest of the Summer run stock group might not be achievable.

APPENDIX H: 2002 REGULATIONS

The Fraser River Panel approved regulations for the management of the Fraser River sockeye and pink salmon fishery in Panel Area waters and submitted these to the Pacific Salmon Commission. The Commission approved the Fishery Regime and Regulations and submitted these to the respective national governments for approval on June 27, 2002.

Canadian Fraser River Panel Area

In accordance with Article VI, Paragraph 5 of the Pacific Salmon Treaty, the Commission recommends to Canada the adoption of the following Fishing Regime developed by the Fraser River Panel, namely:

1. a) No person shall commercially fish for sockeye or pink salmon in Pacific Fishery Management Area 20-1, 3 and 4 with nets from the 30th day of June, 2002, to the 7th day of September, 2002, both dates inclusive.

   b) No person shall troll commercially for sockeye or pink salmon in Pacific Fishery Management Area 20-1, 3 and 4 from the 30th day of June, 2002, to the 7th day of September, 2002, both dates inclusive.

2. a) No person shall commercially fish for sockeye or pink salmon in Pacific Fishery Management Areas 17 and 18 with nets from the 30th day of June, 2002, to the 28th day of September, 2002, both dates inclusive.

   b) No person shall troll commercially for sockeye or pink salmon in Pacific Fishery Management Area 18-1, 4 and 11 from the 30th day of June, 2002, to the 28th day of September, 2002, both dates inclusive.

3. a) No person shall commercially fish for sockeye or pink salmon with nets in Pacific Fishery Management Area 29 from the 30th day of June, 2002, to the 12th day of October, 2002, both dates inclusive.

   b) No person shall troll commercially for sockeye or pink salmon in Pacific Fishery Management Area 29 from the 30th day of June, 2002, to the 12th day of October, 2002, both dates inclusive.

4. The following Fraser River Panel Area waters are excluded:

   a) High Seas westerly of the Bonilla Point-Tatoosh Island Lighthouse Line.

   b) Pacific Fishery Management Area 19, Area 20-2 and 5 to 7 and Area 29-8.

   c) Commercial troll fishing in Pacific Fishery Management Area 17, Area 18-2, 3 and 5 to 10.

During the 2002 season, the Fraser River Panel will adopt Orders establishing open fishing periods based on a 2002 Management Plan adopted by the Panel. This Plan will be designed to achieve Pacific Salmon Treaty-mandated conservation objectives, international allocations of the catch, and domestic goals of the Parties.

United States Fraser River Panel Area

In accordance with Article VI, Paragraph 5 of the Pacific Salmon Treaty, the Commission recommends to the United States Government the adoption of the following Fishing Regime developed by the Fraser River Panel, namely:

Treaty Indian Fisheries:

1. No Treaty Indian shall commercially fish for sockeye or pink salmon in Puget Sound Salmon Management and Catch Reporting Areas 4B, 5 and 6C with drift gillnets or purse seines from the 30th day of June, 2002 to the 7th day of September, 2002, both dates inclusive.

2. No Treaty Indian shall commercially fish for sockeye or pink salmon in Puget Sound Salmon Management and Catch Reporting Areas 6, 6A, 7 and 7A with nets from the 30th day of June, 2002, to the 14th day of September, 2002, both dates inclusive.

3. No Treaty Indian shall commercially fish for sockeye or pink salmon with nets in that portion of Puget Sound Salmon Management and Catch Reporting Area 7A lying westerly of a straight line drawn from the low water range marker in Boundary Bay on the International Boundary through the east tip of Point Roberts in the State of Washington to the East Point Light on Saturna Island in the Province of British Columbia from the 15th day of September, 2002, to the 28th day of September, 2002, both dates inclusive.

All-Citizen Fisheries:

1. No person shall fish for sockeye or pink salmon in Puget Sound Salmon Management and Catch Reporting Areas 4B, 5, and 6C with nets from the 30th day of June, 2002, to the 7th day of September, 2002, both dates inclusive.

2. No person shall fish for sockeye or pink salmon in Puget Sound Salmon Management and Catch Reporting Areas 6, 6A, 7 and 7A with nets from the 30th day of June, 2002, to the 14th day of September, 2002, both dates inclusive.

3. No person shall fish for sockeye or pink salmon with nets in that portion of Puget Sound Salmon Management and Catch Reporting Area 7A lying westerly of a straight line drawn from the low water range marker in Boundary Bay on the International Boundary through the east tip of Point Roberts in the State of Washington to the East Point Light on Saturna Island in the Province of British Columbia from the 15th day of September, 2002, to the 28th day of September, 2002, both dates inclusive.

The following Fraser River Panel Area waters and fisheries are excluded:

Treaty Indian and All-Citizen Fisheries:

1. High Seas westerly of the Bonilla Point-Tatoosh Island Lighthouse Line.

2. Puget Sound Salmon Management and Catch Reporting Areas 6B, 6D, 7B, 7C, 7D and 7E.

During the 2002 season, the Fraser River Panel will adopt Orders establishing open fishing periods based on a 2002 Management Plan adopted by the Panel. This Plan will be designed to achieve Pacific Salmon Treaty-mandated conservation objectives, international allocations of the catch, and domestic goals of the Parties.

APPENDIX I: 2002 FRASER RIVER PANEL IN-SEASON ORDERS

To provide for adequate escapement of the various stocks of Fraser River sockeye salmon and for the prescribed allocation of catch: (a) internationally, between the United States and Canada and (b) domestically, among the commercial user groups in Canada and the United States, the Fraser River Panel formulated the following orders to regulate Panel Area fisheries in 2002.

July 19 United States:
Treaty Indian Fishery
Areas 4B, 5 and 6C:
Open to drift gillnets 12:00 p.m. (noon), Sunday, July 21, to 12:00 p.m. (noon) Wednesday, July 24.

July 23 United States:
Treaty Indian Fishery
Areas 4B, 5 and 6C:
Extended for drift gillnets from 12:00 p.m. (noon), Wednesday, July 24, to 12:00 p.m. (noon) Saturday, July 27.

July 29 Canada:
Area 20-1, 3 and 4:
Open to Area B purse seines from 6:00 a.m. to 9:00 p.m., Thursday, August 1. Further details concerning specific regulations for this fishery will be announced by Fisheries and Oceans Canada.

Area 29 - 7 and 9 to 17:
Open to Area E gillnets with 100 fathom net from 8:00 a.m. to 11:00 a.m., Thursday, August 1, with a possible extension to 2:00 p.m., Thursday, August 1, to be decided on the fishing grounds.

United States:
Treaty Indian Fishery
Areas 4B, 5 and 6C:
Open to drift gillnets from 4:00 p.m., Monday, July 29, to 12:00 p.m. (noon), Friday, August 2.

Areas 6, 7, and 7A:
Open to nets from 4:00 a.m. to 8:00 p.m., Wednesday, July 31.

August 1 United States:
All-Citizen Fishery
Areas 7 and 7A:
Open to purse seines from 9:00 a.m. to 3:00 p.m., Friday, August 2.
Open to gillnets from 4:00 p.m. to 10:00 p.m., Friday, August 2.

August 2 Canada:
Area 18 – 1, 4 and 11:
Open to Area H commercial trolling 12:01 a.m., Saturday, August 3 to 11:59 p.m., Monday, August 5, with a review on Monday, August 5.

Area 29 – 7 and 9 to 17:
Open to Area E gillnets with 100 fathom net, 8:00 a.m. to 11:00 a.m., Tuesday, August 6, with details of regulation to be announced on Monday, August 5.

United States:

Treaty Indian Fishery

Areas 4B, 5 and 6C:

Open to drift gill nets from 4:00 p.m., Friday, August 2, to 12:00 p.m. (noon) Monday, August 5.

Areas 6, 7 and 7A:

Open to net fishing from 6:00 a.m. to 11:00 p.m. Saturday, August 3.

All-Citizen Fishery

Areas 7 and 7A:

Open to reef nets from 5:00 a.m. to 9:00 p.m., Saturday, Sunday, and Monday, August 3, 4, and 5.

August 5 Canada:

Area 29:

Open to Area E gillnets with 100 fathom net, 8:00 a.m. to 11:00 a.m., Tuesday, August 6 in a portion of Area 29-9 eastward of a line from the 7A navigational light on Steveston Jetty, to the white boundary sign on Albion dyke number 2 and in Canoe Passage eastward of the 2nd downstream piling, and sub-areas 29 –11 to 17.

August 6 United States:

Treaty Indian Fishery

Areas 4B, 5 and 6C:

Open to drift gillnets from 4:00 p.m., Tuesday, August 6, to 12:00 p.m. (noon) Friday, August 9.

All-Citizen Fishery

Areas 7 and 7A:

Open to purse seines from 2:00 p.m. to 3:00 p.m. Thursday, August 8, and gillnets open 4:00 p.m. to 8:00 p.m., Thursday, August 8 in the area southerly and easterly of a straight line drawn from Iwersen's dock on Point Roberts in the State of Washington to the Georgina Point Light at the entrance to Active Pass in the Province of British Columbia.

August 9 Canada:

Area 20-1, 3 and 4:

Open to Area B purse seines from 6:00 a.m. to 2:00 p.m., Monday, August 12. Further details concerning specific regulations for this fishery will be announced by Fisheries and Oceans Canada.

Area 18 – 1, 4 and 11:

Open to Area H commercial trolling 12:01 a.m., Saturday, August 10 to 11:59 p.m., Sunday, August 11.

Area 29:

Open to Area E gillnets 7:00 a.m. to 8:00 p.m., Monday, August 12, with details of specific fishery regulations to be announced by Fisheries and Oceans Canada.

United States:

Treaty Indian Fishery

Areas 4B, 5 and 6C:

Open to drift gillnets from 4:00 p.m., Friday, August 9, to 12:00 p.m. (noon) Tuesday, August 13.

Areas 6, 7 and 7A:

Open to net fishing from 5:30 a.m. to 5:30 p.m. Sunday, August 11 in the area southerly and easterly of a straight line drawn from Iwersen's dock on Point Roberts in the State of Washington to the Georgina Point Light at the entrance to Active Pass in the Province of British Columbia.

All-Citizen Fishery

Areas 7 and 7A:

Open to reef nets from 5:00 a.m. to 9:00 p.m., Saturday, August 10 and to gillnets from 4:00 p.m. to 8:00 p.m., Monday, August 12 in the area southerly and easterly of a straight line drawn from Iwersen's dock on Point Roberts in the State of Washington to the Georgina Point Light at the entrance to Active Pass in the Province of British Columbia.

August 12 Canada:

Area 29:

Open to Area E gillnets at 7:00 a.m., Wednesday, August 14, with details of specific fishery regulations to be announced by Fisheries and Oceans Canada.

United States:

Treaty Indian Fishery

Areas 4B, 5 and 6C:

Drift gillnets now scheduled to close at 6:00 p.m., Monday, August 12.

All-Citizen Fishery

Areas 7 and 7A:

Open to gillnets from 4:00 p.m. to 8:00 p.m., Monday, August 12 in the area southerly and easterly of a straight line drawn from Iwersen's dock on Point Roberts in the State of Washington to the Georgina Point Light at the entrance to Active Pass in the Province of British Columbia.

August 23 United States:

All-Citizen Fishery

Area 7A:

Open to gillnets from 8:00 a.m. to 8:00 p.m., Saturday, August 24 and Sunday August 25 in the area southerly and easterly of a straight line drawn from Iwersen's dock on Point Roberts in the State of Washington to the Georgina Point Light at the entrance to Active Pass in the Province of British Columbia.

Areas 7 and 7A:

Open to gillnets from 8:00 a.m. to 8:00 p.m., Monday, August 26 in the area southerly and easterly of a straight line drawn from Iwersen's dock on Point Roberts in the State of Washington to the Georgina Point Light at the entrance to Active Pass in the Province of British Columbia.

APPENDIX J: TABLES 1-7

Table 1. Commercial net catches of Fraser River sockeye salmon in Canadian Area 20 (Juan de Fuca Strait) by week for cycle years 1990-2002.

Date *	1990	1994	1998	2002
Jun. 30-Jul. 6	0	0	0	0
Jul. 7-Jul. 13	0	0	0	0
Jul. 14-Jul. 20	0	0	0	0
Jul. 21-Jul. 27	0	0	0	0
Jul. 28-Aug. 3	1,000	399,000	0	184,000
Aug. 4-Aug. 10	787,000	378,000	0	0
Aug. 11-Aug. 17	2,163,000	69,000	0	42,000
Aug. 18-Aug. 24	428,000	0	0	0
Aug. 25-Aug. 31	0	0	0	0
Sep. 1-Sep. 7	0	0	0	0
Sep. 8-Sep. 14	0	0	0	0
Sep. 15-Sep. 21	0	0	0	0
Sep. 22-Sep. 28	0	0	0	0
Sep. 29-Oct. 5	0	0	0	0
Oct. 6-Oct. 12	0	0	0	0
Total	3,379,000	846,000	0	226,000

* Dates for 2002. For other years, data from the nearest week were used.

Table 2. Commercial net and troll catches of Fraser River sockeye salmon in Canadian Areas 17, 18, and 29 (Strait of Georgia and lower Fraser River) by week for cycle years 1990-2002.

Date *	1990	1994	1998	2002
Jun. 30-Jul. 6	0	0	0	0
Jul. 7-Jul. 13	0	0	0	0
Jul. 14-Jul. 20	0	0	0	0
Jul. 21-Jul. 27	0	0	0	0
Jul. 28-Aug. 3	310,000	104,000	147,000	61,000
Aug. 4-Aug. 10	960,000	472,000	0	89,000
Aug. 11-Aug. 17	738,000	454,000	136,000	816,000
Aug. 18-Aug. 24	866,000	279,000	0	0
Aug. 25-Aug. 31	467,000	341,000	0	0
Sep. 1-Sep. 7	9,000	0	0	2,000
Sep. 8-Sep. 14	1,000	0	0	0
Sep. 15-Sep. 21	0	0	0	0
Sep. 22-Sep. 28	5,000	0	0	0
Sep. 29-Oct. 5	0	0	0	0
Oct. 6-Oct. 12	0	0	0	0
Total	3,356,000	1,650,000	283,000	968,000

* Dates for 2002. For other years, data from the nearest week were used.

Table 3. Commercial troll landings of Fraser River sockeye salmon in Canadian Areas 121 to 127 (west coast of Vancouver Island) by week for cycle years 1990-2002.

Date *	1990	1994	1998	2002
Jun. 30-Jul. 6	0	0	0	0
Jul. 7-Jul. 13	4,000	0	0	0
Jul. 14-Jul. 20	2,000	0	0	0
Jul. 21-Jul. 27	0	0	0	0
Jul. 28-Aug. 3	57,000	171,000	0	154,000
Aug. 4-Aug. 10	1,359,000	146,000	0	0
Aug. 11-Aug. 17	461,000	27,000	0	0
Aug. 18-Aug. 24	13,000	7,000	0	0
Aug. 25-Aug. 31	7,000	1,000	0	0
Sep. 1-Sep. 7	2,000	0	0	0
Sep. 8-Sep. 14	1,000	0	0	0
Sep. 15-Sep. 21	0	0	0	0
Sep. 22-Sep. 28	0	0	0	0
Sep. 29-Oct. 5	0	0	0	0
Oct. 6-Oct. 12	0	0	0	0
Total	1,906,000	352,000	0	154,000

* Dates for 2002. For other years, data from the nearest week were used.

Table 4. Commercial net and troll catches of Fraser River sockeye salmon in Canadian Areas 11 to 16 (Johnstone Strait and northern Strait of Georgia) by week for cycle years 1990-2002.

Date *	1990	1994	1998	2002
Jun. 30-Jul. 6	0	0	0	0
Jul. 7-Jul. 13	1,000	0	0	0
Jul. 14-Jul. 20	3,000	0	0	0
Jul. 21-Jul. 27	27,000	0	163,000	0
Jul. 28-Aug. 3	135,000	93,000	657,000	132,000
Aug. 4-Aug. 10	824,000	1,324,000	67,000	67,000
Aug. 11-Aug. 17	817,000	2,509,000	15,000	493,000
Aug. 18-Aug. 24	807,000	1,574,000	0	8,000
Aug. 25-Aug. 31	117,000	526,000	0	96,000
Sep. 1-Sep. 7	4,000	14,000	0	0
Sep. 8-Sep. 14	3,000	2,000	0	0
Sep. 15-Sep. 21	0	0	0	0
Sep. 22-Sep. 28	0	0	0	0
Sep. 29-Oct. 5	0	0	0	0
Oct. 6-Oct. 12	0	0	0	0
Total	2,738,000	6,042,000	902,000	796,000

* Dates for 2002. For other years, data from the nearest week were used.

Table 5. Catches of Fraser River mainstem sockeye salmon in the Canadian Fraser River First Nations fishery by area (Fraser River mainstream or tributary areas) for cycle years 1990-2002.*

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Table 6. Commercial net catches of Fraser River sockeye salmon in United States Areas 4B, 5, 6, 6C, 7, and 7A (Juan de Fuca Strait and northern Puget Sound) by week for cycle years 1990-2002.

Date *	1990	1994	1998	2002
Jun. 30-Jul. 6	0	0	0	0
Jul. 7-Jul. 13	0	0	0	0
Jul. 14-Jul. 20	18,000	12,000	1,000	0
Jul. 21-Jul. 27	10,000	65,000	37,000	14,000
Jul. 28-Aug. 3	443,000	220,000	209,000	214,000
Aug. 4-Aug. 10	0	269,000	99,000	78,000
Aug. 11-Aug. 17	711,000	320,000	176,000	120,000
Aug. 18-Aug. 24	542,000	205,000	0	4,000
Aug. 25-Aug. 31	426,000	669,000	0	5,000
Sep. 1-Sep. 7	0	68,000	0	0
Sep. 8-Sep. 14	0	0	0	0
Sep. 15-Sep. 21	6,000	0	0	0
Sep. 22-Sep. 28	0	0	0	0
Sep. 29-Oct. 5	0	0	0	0
Oct. 6-Oct. 12	0	0	0	0
Total	2,156,000	1,828,000	522,000	435,000

* Dates for 2002. For other years, data from the nearest week were used.

Table 7. Escapements of sockeye salmon to Fraser River spawning areas for cycle years 1986-2002.

DISTRICT	Estimated Number of Adult Sockeye *					Jacks
Stream/Lake	1986	1990	1994	1998	2002	2002
NORTHEAST						
Upper Bowron R.	3,118	7,860	4,380	4,751	8,770	0
STUART						
Early Runs						
Takla L. Streams	4,820	25,197	6,847	21,235	15,462	0
Middle R. Streams	19,882	55,114	17,094	6,911	5,683	0
Trembleur L. Streams	3,882	16,723	5,890	2,806	3,492	0
Early Stuart Total	28,584	97,034	29,831	30,952	24,637	0
Late Runs						
Middle R.	9,940	76,500	29,573	36,675	7,452	0
Tachie R.	13,617	94,570	42,571	92,947	19,608	0
Miscellaneous	5,158	17,979	4,318	6,531	7,438	23
Late Stuart Total	28,715	189,049	76,462	136,153	34,498	23
NECHAKO						
Nadina R. (Late)	130	359	86	756	421	0
Nadina Channel	3,415	5,674	1,922	2,949	1,504	0
Stellako R.	77,177	93,920	137,982	185,592	322,661	0
QUESNEL						
Horsefly R.	144,751	398,468	494,552	743,171	- *1*	0
Horsefly Channel	-	29,274	19,597	24,934	- *1*	0
McKinley Cr.	5,635	11,743	35,747	75,829	- *1*	0
Mitchell R.	30,827	43,755	129,235	310,331	969,571	0
Miscellaneous	254	4,404	7,280	24,984	52,621	0
Quesnel Total	181,467	487,644	686,411	1,179,249	1,022,192	0
CHILCOTIN						
Chilko R. & L.	293,804	815,904	448,815	879,017	382,814 *2*	2,228
Chilko Channel	-	9,934	1,930	-	0	0
SETON-ANDERSON						
Gates Cr.	394	993	0	935	222	885
Gates Channel	3,178	4,381	3,360	6,312	1,951	1,623
Portage Cr.	14,291	18,336	9,270	25,179	14,953	12
NORTH THOMPSON						
Raft R.	2,095	630	1,712	7,198	18,369	92
Fennell Cr.	6,024	11,862	5,919	8,741	7,198	0
SOUTH THOMPSON						
Early Summer Runs						
Seymour R.	126,166	272,041	64,038	34,024	113,408	32
Scotch Cr.	26,624	83,388	73,180	35,937	101,269	0
Anstey R.	7,080	25,297	7,380	4,741	20,034	0
Eagle R.	7,138	4,147	53,796	30,211	64,877	0
Late Runs						
Adams R./Little R.	1,551,867	2,432,828	878,381	1,047,134	4,430,949	123
Adams Channel	-	6,824	2,031	-	5,224	0
Lower Shuswap R.	600,370	983,481	367,661	291,637	780,655	0
Middle Shuswap R.	80,529	96,441	31,806	15,262	106,064	0
Miscellaneous	112,464	198,099	90,799	36,132	209,227	0
Late Total	2,345,230	3,717,673	1,370,678	1,390,165	5,532,119	123
HARRISON-LILLOOET						
Birkenhead R.	335,630	166,773	39,234	295,677	- *1*	0
Harrison R.	7,265	4,515	9,515	4,496	41,542	175
Weaver Cr.	65,846	5,969	20,017	28,021	66,327	13
Weaver Channel	44,892	10,396	44,939	29,071	34,706	5
LOWER FRASER						
Nahatlatch R. & L.	8,996	7,044	6,042	7,993	7,305	15
Cultus L.	3,256	1,860	4,399	1,959	4,873	9
Upper Pitt R.	29,177	12,202	9,500	76,888	90,280	0
Chilliwack L.	1,164	2,230	7,966	1,068	3,841	26
MISCELLANEOUS	6,882	7,170	9,766	10,963	52,350	127
ADULTS	3,657,738	6,064,285	3,128,530	4,418,998	7,973,121	
JACKS	59,706	20,546	4,096	5,599	5,388	5,388
TOTAL NET ESCAPEMENT	3,717,444	6,084,831	3,132,626	4,424,597	7,978,509	

* Estimates are from DFO.

1 No spawning ground estimate in 2002.

2 Includes Chilko Lake and Channel.

APPENDIX K: STAFF OF THE PACIFIC SALMON COMMISSION IN 2002

EXECUTIVE OFFICE

Mr. D. Kowal, Executive Secretary
Ms. J. Bakas, Secretary
Mrs. V. Ryall, Meeting Planner
Ms. T. Tarita, Librarian/Records Administrator

FINANCE AND ADMINISTRATION

Mr. K. Medlock, Controller
Ms. B. Dalziel, Accountant
Mr. A. Mackay, Fund Coordinator

FISHERIES MANAGEMENT DIVISION STAFF

Mr. M. Lapointe, Chief

BIOMETRICS / CATCH STATISTICS GROUP

Mr. I. Guthrie, Head

COMPUTER SERVICES GROUP

Ms. K. Mulholland, Computer System Manager
Ms. S. Wadley, Information Technology Support Specialist

RACIAL IDENTIFICATION GROUP

Mr. J. Gable, Head
Ms. H. Anozie, Scale Lab Assistant
Ms. J. Boffey, Scale Lab Assistant (Term)
Mr. K. Forrest, Racial Data Biologist
Mr. S. Latham, Sockeye Racial Analysis Biologist
Ms. M. Reichardt, Senior Scale Analyst
Ms. J. Sellars, Scale Lab Assistant
Mr. B. White, Pink Racial Analysis Biologist

STOCK MONITORING GROUP

Mr. J. Cave, Head
Mr. P. Cheng, Hydroacoustics Biologist
Mr. A. Gray, Hydroacoustics Biologist
Ms. F. Martens, Hydroacoustics Technician (Term)
Ms. C. Tovey, Test Fishing Biologist
Dr. Y. Xie, Hydroacoustic Scientist